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PAMPHLET

RESULTS OF DUCK-WING COLLECTION IN THE MISSISSIPPI FLYWAY 1959-60

SPECIAL SCIENTIFIC REPORT: WILDLIFE No. 54

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

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United States Department of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife

RESULTS OF DUCK-WING COLLECTION IN THE MISSISSIPPI FLYWAY, 1959-60

Compiled by

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Based on a Cooperative Study
Between the States in the Mississippi Flyway and
the Bureau of Sport Fisheries and Wildlife

U. S. Fish and Wildlife Service
Special Scientific Report--Wildlife No. 54

Washington, D. C.

April 1961

ABSTRACT

During the 1959 hunting season, a sample of 8,000 Mississippi Flyway hunters were provided envelopes and requested to send a wing from each duck they bagged. The more than 10,000 wings received yielded important information on the age, sex, and species composition of the kill. The lowest age ratios were found in the kill of redheads, mallards, canvasbacks, and pintails. Marked regional and chronological differences were observed in the age, sex, and species composition of the kill. The species composition of the wing collection was compared with that reported in the Bureau's Mail Questionnaire Survey. Information was secured on the distribution of the kill by hour of the day, day of the week, and period within the season. The incidence of banded mallards in the wing collection reflected a pronounced drop in the kill in 1959. Although there are a number of complex problems concerning the analysis and interpretation of the data, the results of this survey indicate that it is a promising new method for gathering information on waterfowl populations.

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INTRODUCTION

Sound management of waterfowl populations depends on knowledge of the age, sex, and species of the ducks shot during the hunting season. The proportion of young in the hunting kill provides a clue to waterfowl production and this information can be used in interpreting the effects of changing habitat conditions. Knowledge of waterfowl production also helps in understanding the meaning of mortality rate estimates obtained through the analysis of band-recovery data. Used with banding data, it should also permit "Lincoln Index" population estimates. If age and sex ratios in the hunting kill are known, differences in migratory behavior and different effects of hunting on the different groups can be detected.

Age and sex ratios in the hunting kill of upland game birds and mammals have been obtained from examination of diagnostic parts, such as wings, tails, and legs, that were solicited from hunters (Blouch and Ammann, 1952; and Dow, 1954).

In 1958, we began exploration of the possibility of applying this technique to waterfowl. First, a small-scale pilot study was conducted in western Minnesota to see if hunters would send enough material to make the method practical. Hunter response was considered very satisfactory, for 169 of 666 hunters to whom letters were sent returned 1,099 wings. At the same time, wings of birds of known age and sex were studied in the laboratory and a technique was developed by which the age and sex of mallards could be determined with more than 95 per cent accuracy (Carney and Geis, 1960).

Exploratory studies were expanded in 1959, when a survey was undertaken in the Mississippi Flyway. This paper reports the results of this second study, which was made jointly by the States of the Mississippi Flyway and the Bureau.

Because this was a pilot study, the procedures used in selecting and drawing samples, processing information, and analysing the data must be considered both experimental and developmental. Consequently, some implications of the accumulated data have not been fully explored, and future refinements of techniques can be expected. The objectives of the study were:

1. To determine response rates to requests for wings.
2. To determine the representativeness of the submitted samples by comparing the wing-collection data with data obtained by other methods.
3. To determine the species composition in the hunting kill in various parts of the Mississippi Flyway.
4. To determine age and sex ratios for the commoner species.

ACKNOWLEDGEMENTS

Many agencies and people cooperated in this study. The Mississippi Flyway States of Alabama, Arkansas, Illinois, Iowa, Louisiana, Michigan, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin provided the financial assistance that made the work possible. Mr. Arthur S. Hawkins, Mississippi Flyway Representative, was instrumental in getting the study started and assisted with it throughout. Mr. Richard A. Hunt, of the Wisconsin Conservation Department, made the many arrangements necessary for the part of the work done in Wisconsin. Mr. Laurence R. Jahn, Wildlife Management Institute, and Chairman of the Research Committee of the Technical Section of the Mississippi Flyway Council, helped greatly in the early stages. The Wisconsin Department of Conservation made available the excellent facilities of the State Game Farm at Poynette, and provided much help in handling the wings. The Superintendent of the Game Farm, Mr. William A. Ozburn, extended every courtesy to us during the work. The personnel at the Game Farm performed the tedious work connected with receiving the wings and placing them in storage. The clerical staff at the Game Farm added state and county code numbers to the wing-collection data slips.

The participation of many people from several agencies made it possible to process the large number of wings in two short sessions. The list below shows the persons and agencies who assisted in interpreting the wings at Poynette. It is possible that names of some participants were inadvertently omitted because of the difficulties associated with irregular working hours.

Wisconsin Conservation Department:	William Bayer	Arlyn Linde
	Caroll Besadny	Harold Mathiak
	John Gates	Ron Melville
	James Hale	John Millar
	Richard Hunt	Fred Wagner
	George Knudsen	Eugene Woehler
Tennessee Game and Fish Commission:	Cal Barstow	
Ohio Division of Wildlife:	Delmar Handley	
University of Minnesota:	David Olson	
University of Wisconsin:	Alex Dzubin	
	Lloyd Keith	
Iowa Department of Conservation:	William Brabham	
	James Sieh	

Illinois Department of Conservation: Paul Moore

Minnesota Department of Conservation: Bob Jessen

Louisiana Wild Life and Fisheries Commission: Morton Smith

West Virginia Department of Conservation: Jack Donnelly

Bureau of Sport Fisheries and Wildlife:

Samuel Carney	Merrill Hammond
Vernon Conover	Arthur Hawkins
Herbert Duncan	Harvey Nelson
Aelred Geis	John Waters
William Green	

Supplemental wing collections from the Central and Pacific Flyways were made by personnel in the Refuge Branch of the Bureau of Sport Fisheries and Wildlife. Supplemental samples of wings also were made by many different people in the Mississippi Flyway at the request of Arthur S. Hawkins.

Many individuals and State and Federal agencies contributed the known-age material from which techniques were derived for determining the age and sex of many species of ducks.

Perhaps most important, approximately 1,440 duck hunters sent the wings that made the study possible.

PROCEDURES

Selection of the Hunters Sampled

Hunters from whom wings were solicited were selected from respondents to the Bureau's Annual Mail Questionnaire Survey of Waterfowl Hunters for 1958 and 1957. Records of two years were used in the selection because names and addresses of some of the respondents had been destroyed during a fire in the Machine Data Processing Room at Patuxent.

These lists were then reduced by removing the names of all persons under 16 years of age and of all others who reported that they had killed no ducks. Hunters who did not kill ducks were removed from the list because we believed that their kill in 1959-60 probably would make up a very small portion of the total, and that therefore the expense of including them in the survey was

not justified. The list included 8,076 hunters from 14 States of the Mississippi Flyway. The numbers of hunters from different localities are shown in the appendix.

The Mail Questionnaire Survey, from whose respondents our list was drawn, is conducted by the Bureau each year for the purpose of determining the number of birds killed, hunter activity, and certain other facts concerning hunting. Persons included in this survey are chosen as follows: a certain number of post offices selling Migratory Bird Stamps are selected at random and the local postmaster at each is requested to give each duck-stamp buyer a franked postcard on which the buyer is asked to provide his name and address. Each hunter who sends in a card is mailed a questionnaire shortly after the colse of the season in his State. Hunters who do not respond to the first questionnaire are sent a second one in about 3 weeks. Approximately 70 per cent of the hunters who receive questionnaires ultimately return them. The number of names and addresses to which questionnaires are sent is approximately half of the number of stamps sold at the sample post offices. The reason is partly that some hunters do not send in the cards, but also partly that some stamp purchasers are not given cards and that some stamps are purchased for resale (a common occurrence in some areas).

The Mail Questionnaire Survey was not designed originally to obtain duck kill estimates with narrow confidence limits for a single State. Consequently, despite the use of names of respondents from two years, only a small number of names and addresses was available for some States and for others the geographic distribution of the sample obviously was not representative of the State as a whole.

The Wing Collection Envelope and Request Letter

The wing-collection envelopes were made of 32-pound Kraft paper, measured 8½" x 11½", opened at the end, and had a center seam and a clasp fastening (Figure 1). Before these envelopes were sent to the hunters, a post office number (which identified the city in which the stamp was purchased) was placed on each. Another number placed on the envelope before mailing showed the number of ducks that particular hunter had reported on the Mail Questionnaire Survey. A third number, identifying the particular hunter, was added to envelopes sent to Arkansas, Illinois, Michigan, and Wisconsin.

Each hunter's allotment of wing envelopes and an explanatory letter (Figure 2) were mailed to him in a 9½" x 12" envelope.

Number of Wing Envelopes Sent to Hunters

The number of envelopes sent to each hunter depended on the number of ducks he had reported in the Mail Questionnaire Survey. Each hunter who reported 20 ducks or fewer was sent three more envelopes than the number of ducks he had reported killing. Hunters who had reported more than 20 ducks were sent 25 envelopes. We hoped that by this system nearly all hunters would have as many envelopes as they could use.

Examination of the Wings

Envelopes for the wings were addressed to the State Game Farm, Poynette, Wisconsin. When the wings arrived there, the Wisconsin Department of Conservation received them and stored them in a freezer until the time for examination.

A total of 10,545 wings was received from the Mississippi Flyway in response to letters requesting their cooperation (Table 1). Of these, 67 were from geese, coots, grebes, and pheasants, and are not considered further in this report. An additional 21 wings were improperly cut or disfigured in some manner and could not be identified to species. In addition, 65 wings were received from outside the Flyway (Table 2) and 117 wings were received from volunteers within the Flyway who were not sent request letters (Table 3).

Complete identification of all species was not possible. The two goldeneyes (Common and Barrow's) were not separated. Three mottled ducks were identified in the Louisiana sample; others may have been present, but if so, they were classified as black ducks. There may have been some confusion between female common and female red-breasted mergansers. Common and scientific names of all species encountered are given in Table 4. A number of black duck x mallard hybrids were identified, but because all gradations between the two species appeared to exist among the sample wings, this separation was somewhat arbitrary. Wings from all other species could be identified.

Examination of wings and recording of data were done by an "assembly line" of personnel from many of the States and from the Fish and Wildlife Service. Two sessions were held: December 9-12, 1959 and February 1-6, 1960. During these sessions, the envelopes were sorted according to species and the A.O.U. number of the species was stamped on the envelope. Wings from each species then were examined separately to determine age and sex. These data were recorded by circling the appropriate figures in a form that had been added to the envelopes by hand stamping. All age and sex determinations were verified by at least one biologist who was thoroughly familiar with the procedure.

Both age and sex determinations are believed to have been accurate for mallards, American widgeons, shovelers, pintails, canvasbacks, redheads, and lesser scaup. Sex determinations for blue-winged teals and wood ducks were accurate, but age determinations were known to be accurate only through the month of October, because known-age material from later months had not been available for study. Age determinations probably were accurate for both black ducks and ringnecks, but at that time the sex of neither could be determined. The age and sex of both buffleheads and goldeneyes may have been accurate, but no quantitative analysis of known material had been made. Age and sex determinations of gadwalls, greenwings and greater scaup were of unknown accuracy.

The wings were discarded after they had been examined and verified. The greater part of the wing envelope was trimmed away with a paper-cutter, leaving a slip approximately 5" x 8" containing the data. State and county codes were added to these slips, which then were taken to the Patuxent Wildlife Research Center, where all data were transferred onto data cards.

Weighting Procedures

There were marked differences among the States in the proportion of the hunters that were sent requests for wings. For example, approximately one of every 80 Minnesota hunters but only one of every 310 Indiana hunters was asked to send wings. As a result, the wings received from the various States represented different fractions of the total kill. Therefore, whenever data from two or more States were combined they were weighted to give each State the proper influence in the over-all average.

For future wing collections, it may be desirable also to weight data within States, but for the present we lack the information that would make it possible. For this year, when we believed certain State samples were either too small or distributed too poorly we simply excluded data from these States from certain averages (in each such instance, this fact is noted on the table concerned). States where the sample was judged adequate in size and distribution were Illinois, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.

There are several possible methods for weighting the data, but none seems entirely satisfactory. Our method is discussed below. It is described for mallard sex ratios (males per female), but the general statements refer to other ratios as well. We first weighted the number of wings in each category separately (as, male mallard wings and female mallard wings), then calculated the ratio of these two

weighted sums. This method was preferred because weighting factors and weighted values were more easily understood and computations were easier than they would have been if ratios had been calculated for each State separately and these ratios weighted. The weighted State total is the number which would have been expected had request letters to hunters in each State been in proportion to the number of hunters in the State. Our ratios are the same as ratios of weighted mean numbers of wings per contacted hunter (weighted in proportion to stamp sales).

The calculation of "weighting factors" is shown in Table 5. The proportion of stamps sold in a State was divided by the proportion of all hunter contacts that were made in the same State.

The stamp sales in 1958-59 are believed to be a good measure of relative numbers of hunters from State to State, because the relative size of sales remain nearly constant from year to year even though the total numbers of stamps sold may fluctuate. This is shown in Table 29, where almost identical averages resulted from weighting the species-composition data by stamp sales records from two different years.

The next step in calculating the weighted ratio was to multiply the weighting factor from Table 5 by the number of wings received in the category concerned. For example, for Minnesota, the number of male mallard wings was multiplied by 0.70, and for Indiana, by 2.68. These weighted numbers for the different States were added together and used as the numerator in calculating the weighted ratio: mallard males per female.

An important assumption, however, is that the mean number of wings received per contact is related in the same manner in all States to the mean kill per stamp buyer. It is not necessary, nor is it necessarily to be expected, that the mean number of wings received per contact equals the mean kill, but it is necessary that bias be constant from State to State. There is a little information that bears on this point:

(a) Response rates apparently are not uniform from State to State. The over-all response rate was remarkably uniform for the four States where hunters were identified by number (Wisconsin, Michigan, Illinois, and Arkansas; see Table 6) even though response rate seemed correlated with success in a previous year. Later, however, the response rates were found to be much lower in certain southern States; this fact appeared when we assembled names of 1959-60 respondents for use in 1960-61. To help understand response rates further, each hunter was assigned an individual number in the 1960-61 wing collection.

(b) The relation between wings sent in by a hunter and the number of ducks killed by the same hunter is not directly measurable from the data at hand. There apparently is a relationship between the kill reported one year and the number of wings sent the next (Table 6); this suggests that there may be a relationship within the same year.

(c) The relationship in a area between the average number of ducks killed per respondent and the average number killed by all hunters cannot be examined with available data. The non-response fraction in the mail survey prevents such a direct measurement.

Beyond their use in calculation, the weighting factors shown in Table 5 indicated the extent and direction the numbers of wings collected from each State must be adjusted in order to obtain a properly weighted total. Thus, for Ohio, the weighting factor of 0.52 indicates that Ohio was relatively oversampled, since the original numbers must be reduced by almost one-half before the Ohio data can be combined with the weighted totals from other States.

RESPONSE RATES

Response Rates from Individual States

Letters requesting wings were mailed to 8,076 hunters, but the Post Office Department was unable to deliver 79 of the letters. Thus, 7,997 hunters received letters. The accompanying wing envelopes totaled 88,661.

Response rates were calculated for the four States (Arkansas, Illinois, Michigan, and Wisconsin) where numbers to identify individual hunters had been added to the wing envelopes. The response rate for these four States varied from 21.9 to 24.2 per cent (Table 6). These rates were close to the 25.2 per cent response rate of the 666 hunters included in the Minnesota Pilot Study in 1958. As discussed later, however, Table 6 shows also that response rates of the more successful hunters tended to be higher than those of the less successful. Therefore, different proportions of hunters in the different success categories could change the over-all response rate. The response rate in Illinois may have been increased by the follow-up letter (see page 11). Response rates for other States could not be calculated directly because envelopes did not have numbers that identified individual hunters. A count of hunters' names written on the envelopes received from certain States, however, indicated that the response rate was much lower (14.3-10.3 per cent) in Indiana, Kentucky, Louisiana, Mississippi, and Tennessee. In the 1960 wing collection, all hunters will be assigned numbers so that response rates can be computed.

Factors Affecting Response Rates

Hunting Success

Response rates were calculated for various hunter-success groups (Table 6), and proved to be related to the size of the kill previously reported on the Mail Questionnaire Survey. The higher response rates of the more successful groups of hunters probably reflected more successful hunting and perhaps also more interest in cooperating among hunters in the more successful groups. There is also a positive correlation between the wings received per respondent and the reported kill. If it is assumed that there is a relationship between kill and number of wings sent in it might be inferred that there is a relationship between the number of birds the hunter actually kills and the number he reports on the Mail Questionnaire Survey. Response rates of the lowest success group may have been slightly reduced by the system of envelope allocation (see page 12).

The Follow-up Letter

A letter reminding hunters to keep sending wings was sent at or near the middle of the season to half of the hunters of the States of Michigan, Illinois, and Arkansas. Hunters having odd identification numbers were sent follow-up letters and those having even numbers served as a control. Hunters' numbers were originally assigned by grouping all hunters by post offices of stamp purchase, placing those post offices in alphabetical order, and then numbering the hunters consecutively.

In all three States, response rates of hunters who received follow-up letters were slightly higher than those of hunters who did not receive the letters (Table 7). Also, after the time when letters were received, those hunters that received letters returned relatively more wings than did those who did not receive letters. It is apparent that in this study the follow-up letter increased late-season responses. It is possible, however, that if there were different patterns of duck availability in different years, follow-up letters would have different effects and the comparability of the data would be reduced. For example, if there were differences in the time of the peaks of migration, follow-up letters might arrive in an area one year during a period when large numbers of ducks were present and another year arrive when very few were present. Response rates could be greatly altered by such a circumstance. If no follow-up letter were used it seems likely that results would be more consistent from year to year. We believe follow-up letters should not be used because of the possibility of complicating rather than simplifying the interpretation of response rates.

Adequacy of Envelope Supply

As discussed in the section on procedures, the number of envelopes sent to each hunter depended on the number of ducks he had reported in the Mail Questionnaire Survey. To learn whether hunters received enough envelopes, the per cent of respondents who utilized all of their original envelopes was calculated for each success group(Table 8). Sixteen per cent of the respondents who received 8 or fewer envelopes returned them all, but only about 5 per cent of the respondents who received 9-25 envelopes returned them all. Only 10.6 per cent of all respondents used all their original envelopes. This percentage is small enough that lack of envelopes could not have introduced a serious bias in the data. In future surveys, however, the numbers of envelopes will be increased.

Supplemental Shipments of Envelopes

The explanatory letter (Figure 2) asked the hunter to send the Bureau a post card if he needed more envelopes. Sixty-seven requests for additional envelopes were received. Forty-three of these were from hunters whose names were part of the original sample, and 24 were from volunteers who had not been sent an original shipment. Hunters who asked for envelopes without specifying the number were sent 10, and hunters who asked for a specific number of envelopes were sent the number they requested. In addition to the post-card requests for envelopes, a number of hunters wrote requests on the envelopes in which they sent wings. These requests were not found until the time the wings were examined after the close of the hunting season. In the 1960 wing survey, an addressed air-mail post card will be included with the wing envelopes to make it easier for the hunter to write for more envelopes.

Use of the extra envelopes that were requested is shown in Table 9 for those hunters who could be identified from individual numbers. Many of the extra envelopes were used, although some hunters apparently overestimated their needs.

CHRONOLOGICAL DISTRIBUTION OF THE KILL

Distribution Through The Season

The seasonal distribution of wings received was compared with the seasonal distribution of the kill reported on the Mail Questionnaire Survey (Table 10). Both surveys indicated that the kill was more heavily concentrated early in the season and that the differences were greater in some States than in others. The Mail Questionnaire Survey indicated much less difference among States in the seasonal distribution of the kill than did the wing collection. The Mail

Questionnaire Survey showed less tendency for the kill to be concentrated early in the season than did the wing collection. The greater proportion of early season responses in the wing collection may have been caused in part by hunters exhausting their envelope supply. There also may have been a tendency to send wings at a proportionally greater rate early in the season.

It is possible also that responses to the Mail Questionnaire Survey were somewhat inaccurate, for in filling the questionnaire form from memory after the close of the season, hunters may have reported the kill as spread more evenly through the season than it actually was. This is suggested by the occurrence on the questionnaire of kills indicated before and after the season. It seems likely that the Wing Collection and the Mail Questionnaire Survey both provide indexes of the kill pattern within the season, but that neither survey truly portrays the distribution of the actual kill. A third estimate of seasonal distribution of the kill will be available from band-recovery data when the banding records can again be used.

Distribution by Days of The Week

Index values representing the relative amount of the kill on each day of the week are presented in Table 11. The values shown in the table for a particular day were computed by dividing the average kill for that day by the sum of the average kills for all seven days of the week. This method of computation was followed to compensate for some week days occurring more often in the season than others. Opening day was omitted from the calculations because the kill occurring then usually was large enough to increase greatly the average for that day regardless of its position within the week. In all States except Mississippi and Arkansas, the largest kill was on Saturday and the second largest kill was on Sunday. In Mississippi and Arkansas the largest kill was on Sunday and the second largest kill was on Saturday. Sunday was closed to hunting in Ohio and Indiana and the kill on Saturday was relatively greater than in States where both Saturday and Sunday were open. The data from Ohio also suggest that the kill on Monday increased slightly when Sunday was closed. If Sunday is excluded from the calculations in Illinois and Michigan, the kill patterns throughout the week in these States become very similar to those in Ohio (Table 12).

Distribution Through The Day

The time of day the bird was killed was indicated on approximately 88 per cent of the wing envelopes received. These served as the basis for Tables 13 and 14 which present the reported distribution of the kill within the day. To arrange this information in a comparable form

for the different States, it was necessary to determine the length of the legal hunting day during various periods in the various States. The times of sunrise and sunset were computed for a central geographic location in each State from tables in The 1959 World Almanac and Book of Facts (H. Hansen, 1959). Each month of the season was divided into 3 ten-day periods, and the times of sunrise and sunset were computed as accurately as possible for the middle of each of these periods. Thus, hours shown in the table were computed from times of sunrise and sunset at the approximate center of the State on or about the 5th, 15th, or 25th of a month during the hunting season. The differences between these times and the actual times of sunrise and sunset in any specific locality could account for the small fraction of birds listed as having been killed either slightly before or after legal shooting hours.

Because time of day was computed as the number of hours after sunrise or before sunset, a mid-period of variable length remained. Because the season started at noon on opening day (precluding the possibility of a morning kill), and because opening day differs in importance among the various States, some additional estimates were made that excluded opening day and these also are included in Table 13.

The information in Table 13 shows that the greatest kill occurs in the first or second hour after sunrise. The rate in the afternoon usually was lower than in the early morning and was more evenly distributed. There was a tendency in most States for the kill during the hour before sunset to be lower than in the second hour before sunset. This result was not anticipated, for we had suspected that the rate of kill would be higher in the last hour before sunset because of greater activity of ducks then. There must have been a reduction in hunter effort just before sunset.

Between two-thirds and three-quarters of the kill occurred between one hour after sunrise and one hour before sunset. Exceptions occurred in Arkansas and Louisiana, where the kill was strongly concentrated early in the morning. This suggests that the further reduction of the hunting hours after sunrise or before sunset would not markedly affect the total kill in most States. In the 1960 Wing Collection we hope to obtain data to evaluate the importance of the kill during the half hour before sunrise.

The data suggest that relatively more diving ducks than dabbling ducks were taken in the morning. The proportion of all species of ducks killed during the morning was considerably greater in the southern States of the Flyway than in the northern States. It seemed that this could have been a result of better hunting that permitted hunters to secure the daily bag limit earlier in some areas than in others. It seemed possible that if a hunter did not bag the limit, he would

continue to hunt later into the day. To test this idea, the number of hunter-days on which the various size bags were obtained was extracted from the 1959-60 Mail Questionnaire Survey from Minnesota, Michigan and Arkansas (Table 15). No ducks were reported killed on approximately half of the total hunter-days in each State. The lowest proportion of unsuccessful days, 44 per cent, occurred in Minnesota, and the highest, 62 per cent, occurred in Michigan. In Minnesota, where the bag limit was three ducks, hunters reported that on 24.5 per cent of the days hunted they shot their limits as compared to 7.0 per cent in Michigan and 15.6 per cent in Arkansas. Percentages of the kill during the 4 hours before sunset were 31.6 in Minnesota, 35.5 in Michigan, and 12.2 in Arkansas, with no correlation with success. This suggests that high success is not likely the only reason the duck kill was more concentrated in the morning in some States than in others.

SPECIES COMPOSITION

The Mississippi Flyway as a Whole

The mallard was by far the most abundant species in the kill. Mallard kills comprised 46.6 per cent of the weighted Flyway total (Table 16). The lesser scaup was next most abundant. The scaup kill, however, was only one-fifth that of the mallard. The next most numerous species in the bag were, in order: the green-winged teal, blue-winged teal, ring-necked duck, black duck, American widgeon, wood duck, and pintail. The remaining 14 species made up only 11.2 per cent of the kill. Canvasback, redhead, and ruddy duck, the species with a special combined daily bag limit of one, made up only 2.1 per cent of the total kill.

Abundance of Certain Species In The Kill In Various Areas

The mallard was the commonest species in the kill in every State in the Flyway except Alabama (only 78 wings, one of the smaller samples). The mallard kill varied from 18.3 per cent of the total kill in Michigan to 91.5 per cent in Arkansas.

Blue-winged teal were numerous in the kill in the north only in Minnesota, Wisconsin, and Michigan, where the season opened earliest; and in the south only in Louisiana, where some bluewings winter.

Black ducks made a progressively larger component of the kill from west to east across the Flyway. They were much more abundant in northern parts of the Flyway, but the west to east increase also could be seen in the Gulf States.

Green-winged teal made up a fairly uniform proportion of the kill in the different States across the northern portion of the Flyway. They were relatively less numerous in the southern than in the northern States. The green-winged teal was the second commonest species in the bag in Iowa and Illinois. It ranked third in Ohio and fourth in Minnesota, Wisconsin, and Michigan.

Gadwalls made up a small portion of the kill in nearly every State in the Flyway. Ohio was the only State from which no gadwall wings were received (except for Kentucky, from which the total sample was inadequate). The poor geographic distribution of the Louisiana sample probably reduced the proportion of gadwall wings received.

American widgeon made up a consistently small proportion of the kill in all States.

Shovelers were less common than American widgeon but appeared to compose about the same proportion of the kill in all States of the Flyway.

Pintails made up a relatively small portion of the kill throughout the Flyway except in Louisiana, where they made up 16.3 per cent. The sample was concentrated in the western portion of the State.

The wood duck made up 23.5 per cent of the total kill in Ohio, almost equalling the mallard. Wood ducks also may be substantial components of the kill in Indiana, Alabama, and Mississippi. Samples from these States were small, however.

Both redheads and canvasbacks made up very small percentages of the total kill and these primarily in the more northern States. Redheads were approximately twice as numerous in the kill as were canvasbacks. Redheads formed 4.8 per cent of the kill in Michigan, their largest fraction in any State kill.

Lesser scaup made up 10 per cent or more of the kill in Minnesota, Wisconsin, Michigan, and Alabama. It was the second commonest species, in Minnesota, Wisconsin, and Illinois and third commonest in Michigan, Iowa, Missouri, and Alabama. The poor distribution of the sample in Louisiana probably reduced the proportion of lesser scaup.

Ring-necked ducks were most abundant in the bag in the northern most and southern most States of the Flyway. They made up 8.8 per cent of the kill in Minnesota and 6.6 per cent in Wisconsin. They

made up 4.7 per cent of the kill in Louisiana, 8.0 per cent in Mississippi, and 30.8 per cent in Alabama. The sample from Louisiana was poorly distributed and probably did not properly sample the greater part of the ringneck kill in the State (Smith, letter of Oct. 7, 1960). Samples from Mississippi and Alabama were small.

Greater scaup were taken in small numbers throughout the Flyway, but they made up a significant portion of the bag (7.0 per cent) only in Michigan.

Buffleheads were most common in the northern tier of States and Ohio, where their proportion in the kill increased from west to east. They were most abundant in Michigan, where they made up 5.3 per cent of the kill.

Black x mallard hybrids were scarce in the kill of all States, although some may not have been recognized. They were most numerous in the kills from Wisconsin and Indiana, and virtually absent in the kills from the southern half of the Flyway. It is possible that the one hybrid listed for Louisiana was a mottled duck.

The extent to which species composition, as determined from the wing collection, varies among different areas within the same State was examined in the data from Minnesota. Wing samples from Minnesota were divided into four groups that came from zones that conformed roughly to the known distribution patterns of species abundance (Figure 4). The number of wings from mallards, green-winged teal, blue-winged teal, lesser scaup, and ring-necked ducks was determined for each of these areas and the species composition calculated. The species considered were the five most common species in the Minnesota kill, and collectively they made up 77.3 per cent of the State total. The proportions of these five species in the kill in each of the four regions are shown in Table 17 and Figure 4. The table also shows the relative proportions of the kill of all species for each region.

Mallards made up 31.3 per cent of the State kill. Their proportions were approximately equal in the northwestern, north-central and southern parts of the State. In the northeastern area, however, mallards made up only 19 per cent of the total kill.

Green-winged teal made up a sizeable portion (18.4 per cent) of the kill in the southern zone. They were proportionally less numerous in the northern areas: they made up about 7 per cent of the kill in the northwestern and only about 2 per cent of the kill in the northcentral and northeastern areas.

Blue-winged teal also were relatively more numerous in the southern zone, but the difference between zones was not as great as for the green-winged teal. The only zone in which bluewings were distinctly less common in the bag was the northeastern zone, where they made up only 3 per cent of the kill.

Lesser scaup and ringnecks combined made up a very small portion (5.3 per cent) of the kill in the southern zone but a very large portion in the northern zones of the State. Lesser scaup made up from 24-31 per cent of the kill in the three northern zones, and ringnecks made up 18.5 per cent of the kill in the north-central zone and 19.6 per cent in the northeastern zone. The ringneck made up 5.3 per cent of the sample in the northwestern zone.

The species composition of the kill in the four areas of Minnesota was quite different (Table 17). For example, in the northeastern zone both ringneck and lesser scaup made up a larger fraction of the sample than did the mallard. In the southern zone, in contrast, mallards were almost seven times as abundant as the ringnecks and lesser scaups combined. This analysis of the kill distribution within the State of Minnesota shows that it is important to have the wing collection in each State distributed so that the same fraction of the kill is sampled in all areas of the State.

Variation in Species Composition Within The Season

The kill in each State in the Flyway was examined by periods within the season to evaluate the changes in species composition that occurred as the season progressed. The following is a brief account for those States from which samples were large enough to make such comparisons feasible:

Minnesota

Most of the wings received (94.5 per cent) came from birds shot in October. The mallard was the most abundant single species during the first period (4 days), making up 35.6 per cent of the total kill (Table 18). The proportion of mallards in the kill declined to 24.8 and 24.2 per cent during the next two 10-day periods. During the next period, in mid-November, the proportion was approximately 66.7 per cent; at this time relatively few ducks of any kind were being shot. Blue-winged teal made up 18.2 per cent of the kill during the first period then declined abruptly to 3.8 per cent of the kill during the second 10 days. They were viturally absent from the kill by November first. The proportions of wood ducks and ringnecks in the kill also declined after October. Lesser scaup, in contrast, constituted only 2.5 per cent of the kill during the first period, but the proportion increased during

the next two periods to 38.4 per cent of the total kill October 21-31. Lesser scaup continued to make up a substantial part of the kill until the close of the season. Goldeneyes and buffleheads apparently were a much greater proportion of the bag late in the season than they were earlier, although the sample was very small after November 10. Black ducks, gadwall, American widgeon, and green-winged teal appeared to make up fairly constant proportions of the kill throughout the season.

Wisconsin

Mallards consistently composed 25 to 32 per cent of the kill during all periods in the season (Table 19). Black ducks also made up a fairly uniform proportion of the kill throughout the season. The proportion of bluewings declined abruptly from 25.1 per cent of the kill during the first 4 days of the season to 6.2 per cent during the next 10 days of October. Green-winged teal and wood ducks also were relatively more abundant in the bag early in the season, but their proportions declined more gradually than the proportions of bluewings and some birds persisted throughout the season. Proportions of ringnecks increased from 3.6 per cent of the kill during the first period to 14.0 per cent by the end of October. Lesser scaup showed an even greater proportional increase as the season progressed, from 2 per cent of the kill during the first period (October 7-10) to 27.4 per cent during the third period (October 21-31). No goldeneye wings were in the sample taken October 7-10, but goldeneyes made up 5.5 per cent of the sample from November.

Michigan

Mallards were the most numerous ducks in the kill during the entire month of October, when they made up about 20 per cent of the kill (Table 20). In November, however, the proportion of mallards declined to only 9 per cent of the kill. Black ducks made up 14.6 per cent of the kill during the first period and remained at approximately this fraction throughout the season. Bluewings, greenwings, and pintails made up a fairly large part of the kill early in the season, but the proportion declined as the season progressed. The kill of redheads, canvasbacks, both scaup, ringnecks, goldeneyes, and buffleheads was relatively much greater in November than in October. Diving ducks made up only 7.0 per cent of the kill from October 7-10, increased to 54.7 per cent during the last 10 days in October, and to more than two-thirds of the kill during November.

Ohio

The wood duck was the most abundant species in Ohio during the first two periods (Table 21). The proportion of wood ducks in the kill declined greatly after the first of November. Mallards made up 20-30 per cent of the kill throughout the season. Black ducks, widgeon, lesser scaup, and goldeneyes had their highest incidence in the kill during the latest period, November 11-30.

Iowa

During the period of October 11-20, mallards made up 33.3 per cent of the kill, greenwings 20.6 per cent, widgeon 15.9 per cent, and lesser scaup only 1.6 per cent (Table 22). The proportion of mallards became progressively greater until the end of October, when it was 60 per cent. The proportion of widgeon appeared to decline after the first ten days. Greenwings remained proportionally abundant in the kill throughout the season. Proportions of lesser scaup increased from 1.6 per cent of the kill during the first 10 days to 11.2 per cent during the period of November 1-December 10.

Illinois

Mallards constituted 51.3 per cent of the kill during the first ten days and the proportion increased to more than 80 per cent during the final 20 days of the season (Table 23). Proportions of black ducks also increased steadily from 0.5 per cent at the beginning of the season to 6.0 per cent during the final 20 days. Proportions of greenwings declined abruptly after the first period from 13.1 per cent of the kill to 0.5 per cent by the end of the season and proportions of wood ducks declined from 10.5 per cent to 01.1 per cent. Diving ducks were relatively scarce. Proportion of lesser scaup increased from 0.5 per cent of the kill during the first period to 7.7 per cent by mid-season, a pattern characteristic of the species.

Missouri

Mallards dominated the kill from the beginning of the season and their proportion increased greatly at the end of the season (Table 24). The next most abundant species was the green-winged teal, which made up about 11 per cent of the kill during the first 20 days of the season.

Arkansas

Mallards dominated the kill (Table 25). During the first period they constituted 82.8 per cent. This proportion increased to approximately 90 per cent in the second period and remained high during most of the season until January, when it increased further to 98 per cent.

Louisiana

Mallards made up the largest portion of the kill. Their proportion varied from 60.0 per cent during the second 10 day period to 36.4 per cent at the close of the season (Table 26). The relative numbers of bluewings in the bag increased steadily from none during the first 10 days to 25.0 per cent in January. The proportion of pintails remained relatively constant at about 10 per cent of the kill until January, when it abruptly increased to 38.6 per cent. As previously discussed, the Louisiana wing collection was not representative of the State as a whole.

Species Composition in Relation to Reported Hunting Success

The relationship between species composition and hunting success was first examined in the data from the 1958 Minnesota Pilot Study. The most successful group of hunters proved to have a much higher proportion of diving ducks in their kill than did the less successful hunters (Table 27).

The species composition and kill of different success classes of hunters were examined further in the data of the present study. Three success classes were compared for those States having large enough samples (Table 28). Only among Wisconsin hunters was there a strong tendency for the kill of divers to be proportionally higher in the bags of the more successful hunters. It is possible that the reduction of the legal bag of some divers from 4 to 1 in the 1959-60 season may have diverted many hunters from concentrating on diving ducks. Thus, the different results of the studies of the two years may have been produced by changes in hunting regulations. Since relationships between hunting success and species composition could vary from year to year, and also since it seems likely that certain species, such as blue-winged teal and wood ducks, might be taken relatively more often by the low-success category of hunters, it seems advisable to sample all success classes.

Comparison of Species Composition in the Kill as Shown by the Wing Collection and the Mail Questionnaire Survey

A comparison of the species compositions shown by the two surveys was feasible for only seven States of the Flyway because wing-collection samples from some States were too small or not geographically representative. Results of the comparison are shown in Table 29. Data in the table were weighted by the methods described earlier.

The accuracy of the data from the wing collection was reduced to the extent that hunter response was skewed toward the start of the season. The accuracy of the data from the Questionnaire depended on the hunters' ability to recognize the species they shot and to remember the number of each until the season had closed. In spite of these weaknesses in the data of both surveys, both showed quite similar species composition in the kill. Both surveys indicated that the mallard, lesser scaup, green-winged teal, and blue-winged teal, in that order, were the four most abundant species taken in the kill.

Among the top four species, the wing collection suggested that the mallard was slightly less abundant and the blue-winged teal substantially less abundant than did the Mail Questionnaire Survey. Among the less numerous species, ring-necked ducks, American widgeon, and gadwall made up a substantially greater fraction of the kill in the wing collection than was reported in the Mail Questionnaire Survey. The incidence of canvasbacks in the kill was only half as great in the wing collection as in the Mail Questionnaire Survey.

The species compositions shown by the wing collection and that reported on the Mail Questionnaire Survey also were compared for those individual States where the wing collection was of suitable geographic distribution and size (Table 30). As in the previous comparison, over-all agreement was good, although there were some differences.

The largest and most consistent differences between results of the two surveys were that the proportions of mallards and blue-winged teal were higher on the Mail Questionnaire Survey, and the proportions of gadwalls, American widgeon, and ringnecks usually were much lower.

The wing collection indicated a much higher proportion of ringnecks in the kill in Minnesota, Wisconsin, Michigan, Iowa and Ohio than did the Mail Questionnaire Survey. Results of the two surveys were similar for Illinois. Relatively fewer ringnecks occurred in the wing-collection sample from Missouri than were reported on the Mail Questionnaire Survey.

The differences in the ringneck comparisons for Illinois and Missouri suggests the possibility that in States in which mallards make up a large part of the kill, some hunters may think of them as "ringneck mallards" and hence report them as ringnecks.

A. D. Geis and E. L. Atwood (unpublished ms.) examined the recovery records on file at the Banding Office and compared the species composition reported by banders with the species composition of duck returns reported by hunters (for which the hunter named the species). They found that the proportion of mallards was higher and the proportions of nearly all other species of ducks were lower in the reports from hunters than in the reports from the banders (Table 31). Gadwalls and ringnecks were among the species where the differences were greatest. Results from hunters' reports concerning species composition thus differed from the banders' reports in the same general way as results from the Mail Questionaire Survey differed from the wing collection.

AGE RATIOS

Age ratios in the kill are not the same as the age ratios in the population because immatures are more vulnerable to shooting than are adults, as will be discussed later. Age ratios in the kill can, however, be considered as indexes of the age composition of the population unless differential vulnerability varies greatly between years.

Age ratios determined from the wing-collection data are shown in Table 32. The table shows both unweighted and weighted age ratios for each species for the entire Flyway. Weighted and unweighted age ratios usually were essentially the same. Weighted age ratios for black ducks and pintails, however, were substantially lower than the unweighted ratios. This difference resulted because the weighting reduced the influence of the high age ratios of these species in the northern States.

Species Comparisons

The best expression of the age composition of the kill in the Flyway as a whole is the weighted ratio in the right-hand column of Table 32. These data indicate that the redhead, mallard, canvasback and pintail were the four species having the poorest production rate during the 1959 breeding season.

Because the weighting procedure that was followed did not give southern States adequate weight, the weighted age ratios of those species taken in both the northern and the southern ends of the

Flyway probably were higher than they should have been. True age ratios in the kill of these four species, therefore, probably were slightly lower for the mallard and considerably lower for the pintail. Canvasback age ratios are not comparable to those of the pintail and mallard because most of the canvasbacks in the sample were taken during migration. Stewart, Geis, and Evans (1958) found that early in migration, immature canvasbacks tended to be taken in relatively greater proportion than adults. Thus, the canvasback age ratio was biased more in favor of immatures than were the age ratios of other species that not only migrate through the Flyway but also winter there. Since the age ratios in shot samples are higher than the true ratios, because of the greater vulnerability of immatures, it is reasonable to conclude that redheads, mallards, canvasbacks, and pintails had very unsatisfactory production in 1959.

A large part of the population of these species breeds in the southern prairie provinces, where there was a severe drought during the 1959 breeding season.

Among those species for which there were samples of 100 or more wings, the highest age ratios were for greater scaup, bufflehead, green-winged teal, and American widgeon. Since these species tend to be far-northern breeders, it seems likely that they experienced more normal conditions than the four species discussed above.

The significance of the age ratios for the various species will be much greater when comparable data are available from future years.

Mallard

1. Variation among States

Mallard age ratios in the wing collection are shown in Table 33. Mallard age ratios differed among the States in a recognizable pattern. Age ratios in the top two tiers of Mississippi Flyway States increased steadily from west to east. Age ratios from west to east in the northern most tier of States were: Minnesota, 1.20 immatures per adult; Wisconsin 2.13; and Michigan 2.56. In the next tier of States, the series was: Iowa, 0.53; Illinois, 0.64; Indiana, 1.46; and Ohio, 1.55. In all other States of the Flyway, mallard age ratios were consistently low, approximately 0.5 immature per adult. It seems likely that differences in mallard age ratios among States reflected the extent to which the mallards harvested in each State were produced in drought-stricken portions of the breeding range. The States in the north and east tended to have higher age ratios than those in the west and south.

2. Chronological variation

Seasonal changes in mallard age ratios are shown in Table 34 for the entire Flyway. Age ratios dropped markedly during the first three weeks of the season, then from November through the end of the season continued to be less than one immature per adult. The drop in age ratios as the season progressed apparently was due to an increase in the portion of the kill occurring in the southern States, where mallards had low age ratios throughout the season. Changes in the relative vulnerability of the two age groups probably also contributed to the drop. Inspection of the weekly data indicated that weighting of the State data would have little effect on the estimates for the entire Flyway. In most States, age ratios for a given week either were similar to each other or, if they were dissimilar, the State had its proper weight. Data from Minnesota, Iowa, and Ohio were exceptions, so the observed data for those States were weighted as described earlier before obtaining the weighted totals.

Seasonal changes in mallard age ratios in certain States of the Mississippi Flyway are summarized in Table 35. The States included are those having large enough samples to make the comparisons meaningful. Age ratios on opening day are shown also for those States having the largest samples.

The age ratio in Minnesota on opening day was 1.91 immatures per adult, but during the remainder of the first week the average age ratio was 1.11 immatures per adult. This change may have been due to a greater vulnerability of immatures on opening day. During the remainder of the season, age ratios were lower but showed no consistent trend.

In Wisconsin, on opening day, a sample of 30 birds had an age ratio of 5.0 immatures per adult. The age ratio during the remainder of the first week of the season was 2.52. During the period of October 14 through October 27, the age ratio dropped to 1.42, and during the remainder of the season, October 28 through November 25, the age ratio was 1.89 immatures per adult.

In Michigan, age ratios decreased from 4.54 during the first four days of the season to 2.38 during October 12 through 25, then to 1.06 immatures per adult during the remainder of the season.

Age ratios in the first week of the season in Iowa were extremely low, averaging 0.28 immature per adult. Age ratios increased progressively thereafter to 0.45 during the period of October 27 to November 2 and to 1.00 for the remainder of the season (November 3 through December 8). The increase in age ratios during the period November 3 through December 8 probably was due to the arrival of

birds from a more productive area than the areas from which birds had come at the beginning of the season. Age ratios increased in both Minnesota and Wisconsin at the same time as in Iowa.

On opening day in Illinois, the age ratio was 0.79 immature per adult, substantially higher than the age ratio of 0.42 for the remainder of opening week. The following week, November 4 through 10, age ratios increased to 0.85. Age ratios then decreased to 0.53 during November 11 through 17, and increased to 0.80 November 18 through December 8.

Age ratios for Ohio were computed for only two periods because of the small sample size. There were 2.13 immatures per adult in the period of October 16 through November 20 and 1.25 immatures per adult during the remainder of the season.

In Missouri, the age ratios were 0.64 immature per adult on opening day and 0.67 during the remainder of the week. The age ratio remained constant (0.41 and 0.42) during the remainder of the season.

In Arkansas, the ratio was 0.74 immature per adult on opening day, then 0.64 immature per adult during the following four days. Thus, as in the data from Missouri, the age ratio on opening day was not substantially greater than during the remainder of the week. This seems to indicate that the immatures are not more vulnerable than adults by the time the birds reach Missouri and Arkansas. During the period of December 5 through 11 in Arkansas, the age ratio was 0.80. Age ratios during the remainder of the season were much lower.

Age ratios in Tennessee did not show the marked fluctuations between periods that they did in the samples from other States. They were highest during the first week of the season, 0.57 immature per adult. There were 0.40 immature per adult during the period December 7 through 20 and 0.50 immature per adult during the period December 21 through January 8.

In Louisiana, age ratios were 0.70 immature per adult during the period November 26 through December 14 and 0.54 immature per adult during the remainder of the season.

3. Variations in age ratios within States

Examination of the age-ratio data on a county basis in four States having large samples revealed that in two of these there were pronounced differences in age ratios between portions of the same State. Minnesota could be divided into three zones with very

different age ratios (Figure 5). A sample of 216 wings from the northeastern zone averaged 2.93 immatures per adult. The age ratio was 1.44 immatures per adult in a sample of 414 wings from the middle zone (from the northwest corner through the middle portion of the State at the eastern boundary). In the remainder of the State (most of the southern half), the age ratio in a sample of 468 wings was only 0.73 immature per adult. Thus, age ratios increased from west to east and south to north within the State of Minnesota just as they did from State to State. The birds harvested in extreme northeastern Minnesota probably came from an area of relatively successful production, whereas those taken in the southern portion of the State probably came from an area where production had been much poorer.

Age-ratio data from Missouri and Illinois did not show any significant regional differences within the States. Age ratios along the Mississippi River in Missouri, however, were somewhat higher than those in the interior. The age ratio in samples from the counties adjacent to the Mississippi River in Missouri was 0.59 immature per adult, whereas the age ratio in the remaining counties was 0.47 immature per adult.

A sample of 830 wings from the extreme northeastern corner of Arkansas had an age ratio of 0.53 immature per adult. The age ratio in a sample of 52 ducks taken in east-central Arkansas in the vicinity of Stuttgart was considerally lower, only 0.27 immature per adult. This difference suggests that the sample for the State as a whole was not properly representative, and that the age ratio for the State should have been lower.

4. Mallard age ratios from bag checks and supplemental wing collections

In addition to age-ratio data from the wing collections, information on age ratios was obtained by examining ducks stored at locker plants, inspecting hunters' bags, and making supplemental collections. The purpose of the additional effort was to obtain age-ratio information from a wider geographic area than was covered by the mail-wing collection, and to see how well data from bag checks and supplemental wing collections agreed with the data from the mail-wing collection.

Arthur Hawkins summarized the results of bag-check information in the Mississippi Flyway, and distributed the information to Mississippi Flyway Council members in the form of memos during the 1959-60 hunting season. Table 36 summarizes his age-ratio observations as presented in these memos. In Minnesota, age ratios were determined by examining ducks in locker plants in the Twin Cities and in hunters' bags at the Roseau River Refuge. Birds in the locker plants were shot over a

wide area, including some places outside Minnesota. Since the age ratio from the locker-plant examinations was less than one immature per adult, it seems likely that most of the birds came from the southern half of Minnesota, where the age ratio determined from the wing collection was 0.73 immature per adult (Figure 5). Age ratios obtained from bag checks at the Roseau River Refuge in extreme northern Minnesota were much higher: 2.24 immatures per adult in a sample of 402 ducks. In the wing collection, the age ratio in mallards from the area that includes the Roseau River Refuge was 2.93 immatures per adult (Figure 5). Thus, both the locker-plant and bag-check data in Minnesota agree well with the age ratio data from the wing collection.

In Ohio, bags checked at the Erie Marsh (Bednarik, in a letter of July 18, 1960) contained 1.5 immatures per adult. This ratio is very close to the ratio of 1.55 immatures per adult found in the wing collection sample from Ohio.

In Illinois, the mallard age ratio in samples of the hunting kill in the area near the mouth of the Illinois River was 0.43 immature per adult, somewhat lower than the ratio of 0.64 found in the Illinois wing-collection samples. The age ratio among 75 wings from Jersey and Calhoun counties, adjacent to the mouth of the Illinois River, was 0.60 immatures per adult. The bag-check data for Illinois did not include data for opening day which could have contributed to this disagreement.

There was a ratio of 0.6 immature per adult in a sample of 1,283 ducks taken at the Duck Creek Wildlife Management Area near Puxico, Missouri. This is a slightly higher ratio than the 0.51 immature per adult in the wing collection sample from Missouri, but is almost the same as the age ratio in the wing collection sample of 138 mallard wings from hunters in counties adjacent to the Mississippi River.

At Stuttgart, Arkansas, from November 30 to December 1, locker-plant checks revealed 0.3 immature per adult. This ratio agrees almost perfectly with the ratio of 0.27 found in the small wing-collection sample of 52 wings from the Stuttgart area (Figure 5).

The Louisiana Wild Life and Fisheries Commission found an average age ratio of 0.54 in bag checks in several parts of the State (Smith, 1960). This ratio seems to agree well with the ratio of 0.61 immature per adult in the wing collection from Louisiana. The bag checks, however, revealed pronounced differences in age ratios between northern and coastal portions of the State. Since the wing collection did not sample northern Louisiana to the same extent as did the bag checks, the age ratios are not entirely comparable.

In addition to bag-check and locker-plant examinations by biologists, age ratios also were determined in special collections of mallard wings from a number of locations. These data are summarized in Table 37. In many of the special wing collections the individual wings were not placed in separate envelopes. Consequently, the feather structure was considerably disarranged by blood and by being frozen against other wings. Therefore, some of the age and sex determinations made from these wings were not as accurate as those obtained in the mail wing collection. Mr. Eugene DuPont provided a sample of 71 mallard wings taken throughout the season in the Atlantic Flyway, near Georgetown, South Carolina. These wings showed an age ratio of 1.22 immatures per adult, substantially higher than the age ratios shown by the wing-collection sample from the southern half of the Mississippi Flyway. This suggests that even in the southern portions of the Mississippi and Atlantic Flyways there was a trend in the direction of ratios going from west to east.

In the Mississippi Flyway, supplemental wing collections were made in a number of locations. In Manitoba, David Olson arranged for the collection of 1,407 mallard wings at four different locker plants. Only at Winnipeg was the age ratio greater than one immature per adult. The higher age ratios at Winnipeg may reflect a tendency for age ratios in the east and north to be higher than those farther south and west in the same pattern found in Minnesota. In Illinois, Frank Bellrose arranged for the collection of wings in the Central and Crane Lake Clubs along the Illinois River. The wings showed a ratio of 0.44 immature per adult, lower than the ratio of 0.64 in the wing collection sample for the entire State of Illinois. A comparison of the data in Tables 35 and 37, however, shows that this discrepancy was due chiefly to age-ratio differences in the last period, when the collections from the Crane Lake and Central Clubs had only 0.27 immature per adult and the State-wide sample had 0.80 immature per adult. However, in bag checks in the same area, Bellrose found a still lower age ratio than that observed in the wing collection (Bellrose, in a letter of April 8, 1960).

Wings were collected in five different locations in Arkansas. The age ratios in these samples are summarized in Table 37. The samples had the same low age ratios as observed in the wing collection sample from Arkansas. They also suggested a trend toward higher age ratios in the northeast corner of the State. The age ratio in the special collection of wings from Stuttgart was 0.33 immature per adult and the ratio in the wing-collection sample from the same vicinity was 0.27 immature per adult.

In the Central Flyway, a sample of 21 wings was collected in the vicinity of the Lower Souris National Wildlife Refuge in North Dakota. These wings indicated a low age ratio, 0.82 immature per adult. In a sample of 50 mallard wings collected in Colorado, the age ratio was somewhat higher, 1.14 immatures per adult.

In the Pacific Flyway, mallard-wing collections were made in the vicinity of a number of Federal refuges. Near Nampa, Idaho, a ratio of 1.61 immatures per adult was observed in a sample of 89 wings. Age ratios in collections from this area decreased as the season progressed. At Bear River Refuge, Utah, the very low age ratio of 0.37 immature per adult was observed in a sample of 140 wings. Twenty-one mallard wings were collected in the vicinity of Fallon, Nevada. This sample revealed an age ratio of one immature per adult.

In California, good samples of mallard wings were collected at three locations. Near Tule Lake, the age ratio was very low, 0.35 immature per adult. Farther south, near Willows, the age ratio was higher, 1.61 immatures per adult. In the vicinity of Merced, still farther south, the age ratio was 2.57 immatures per adult, one of the highest observed in this study.

The reason for the pronounced difference in mallard age ratios among the three California samples is one of the most perplexing questions arising from this study. Refuge Branch personnel and the Pacific Flyway Representative, John E. Chattin, offered possible explanations for the differences. Chattin (letter of February 25, 1957) pointed out that age ratios among mallards banded prior to the hunting season had for many years consistently shown the same differences in age composition as shown in the wing-collection sample. Age ratios at Tule Lake always were substantially lower than those in the two areas farther south. He stated, "one might theorize from looking at the current results that immature mallards show a strong tendency to move to southern or terminal wintering areas at a faster rate than adults. Adults, on the other hand, tend to remain farther north on migration areas, longer by reason of being better equipped to care for themselves". This theory would explain why the highest age ratios occurred at the most southern collection point. The results of the wing collection do not support this hypothesis, since age ratios in Louisiana were almost as low as those farther north in Arkansas, Missouri, and Illinois. Furthermore, the data in Table 37 indicate that age ratios did not change substantially in the three California collection areas during the season. The pronounced differences among the three areas were much the same throughout the season. The possibility that the

differences in age ratios could have been due in some way to the differences in hunting practices in the three areas was pointed out by a number of refuge managers and by Mr. Chattin. Mr. R. M. Abney, Biologist at the Tule Lake Refuge, (letter of May 23, 1960) reported that the wings received from that area were collected "from birds bagged on refuge public hunting areas, where there was hunting every day of the season, and on a 'free lance' basis. In contrast, the Willows-Merced collections were probably made from State-operated areas and private clubs where hunting management embodied 'rest' days, a limited number of hunters, and perhaps other controls. It is possible that these controls might function in such a way as to make the unwary immatures more vulnerable to the gun." Age ratios in samples of trapped birds suggest that different hunting conditions in the area are at best only a partial explanation. At Tule Lake, prior to the 1959 hunting season, the age ratio in trapped birds was 0.35 immature per adult (Abney, letter of May 23, 1960) while at Merced it was 3.00 immature males per adult male and 2.78 immature females per adult female (Chattin, letter of February 25, 1960). These age ratios from trapped samples are almost exactly the same as those observed in the wing-collection samples from the same areas. This can be taken as evidence that the birds available in these areas prior to the hunting season had the same differences in age composition as later in the season.

Mr. Stroop, refuge manager of the Merced National Wildlife Management Area, offered another suggestion that might help explain the age composition of the wing collection in that area (letter of May 31, 1960). He suggested that locally produced birds could have concentrated in the areas at the time the wing-collection samples were gathered. He pointed out that the hunting area on Merced opened a month later than the general season, and that, therefore, birds produced locally could have been concentrated on the management area by hunting pressure on the outside. Table 37 shows that the age ratio in the hunting kill at Merced dropped substantially after the latter part of December, and so supports Stroop's hypothesis. This drop could have been produced, however, by the arrival of birds having lower age ratios. Despite the possible arrival of birds having low age ratios, age ratios among mallards in the Merced area were much higher throughout the season than those in wing-collection samples from areas farther north in California.

Black Duck

Regional differences in age ratios of black ducks are shown in Table 38. Age ratios declined progressively from north to south. The differences in the age ratios possibly reflect changes in vulnerability of immatures as the season progressed. Bednarik found 2.21 immatures per adult in a sample of 241 black ducks shot at Magee Marsh in northeast Ohio. Although samples of black ducks in the wing collection were small, it was possible to divide the data from

Minnesota, Wisconsin, and Michigan into samples representing different periods during the season (Table 39). In Minnesota and Michigan, there was a sharp drop in the age ratio as the season progressed, while in Wisconsin there was only a slight drop, if any. It seems likely that the higher age ratios in the earlier samples resulted from the young birds being relatively more vulnerable than adults early in the season.

American Widgeon

There were marked regional differences among age ratios of American widgeon (Table 40). There was a tendency for samples from the western States to have a higher age ratio than samples from the eastern States. This trend was evident in the northern tier of States, where samples from Minnesota and Wisconsin showed a higher age ratio than did the sample from Michigan. The tendency was even more pronounced throughout the remainder of the Flyway. In samples from Iowa, Illinois, Missouri, Arkansas, and Louisiana, combined, the age ratio was 3.04 immatures per adult. In contrast, the combined samples from Indiana, Ohio, Tennessee, Mississippi, and Alabama (the easternmost States in the lower portion of the Mississippi Flyway) had an age ratio of only 0.72 immature per adult. Because of the small sample sizes, true differences in age ratios may not have been as great as indicated. Bag checks in Louisiana showed only 0.18 immature per adult among 154 birds; this suggests that there was a low age ratio among birds in the entire southern end of the Flyway. The wing-collection sample from Louisiana contained only 4 birds, so no data are available for comparison. Samples from Minnesota were divided into two periods to see if there was a seasonal change in the age ratio. During the first week in the season, October 7 through 13, the age ratio was 1.38 immatures per adult in a sample of 138 wings. During the remainder of the season there was an age ratio of 0.95 immature per adult, in a sample of 39 wings.

Green-winged Teal

The age ratio in the sample from the northern tier of States was higher than in the samples from the remainder of the Flyway (Table 41). Age ratios were no higher in the second tier of States than in the remainder of the Flyway to the south. Data from Minnesota and Wisconsin indicate that there was little change in age ratios between the first week and the remainder of the season (Table 42). Sample sizes, however, were very small. As discussed earlier, there is also a possibility that green-winged teal were

not aged as accurately as were other species, because the tertial feathers were missing from many of the wings.

Blue-winged Teal

Table 43 shows the regional variations in age ratios of blue-winged teal. In the northern tier of States there was a progressive increase in the age ratios in samples from Minnesota through Wisconsin and Michigan, in much the same manner as was observed for the mallard, except that age ratios generally were higher for the blue-winged teal than for the mallard. Presumably the reasons for the regional differences are the same as for the mallard, i.e., blue-winged teals shot in Minnesota came from an area more adversely affected by drought than did those taken in Michigan. Samples from the second tier of States had an unweighted average ratio of 1.6 immatures per adult in contrast to 1.8 in samples from the northernmost tier. Since these are unweighted averages, the low ratio of the Minnesota sample received undue weight. The true age ratio in the northern tier of States very probably was substantially higher than 1.8. Only 25 blue-winged teal wings were received from Missouri, Tennessee and Louisiana, of which 23 came from Louisiana. The age ratio was remarkably low, 0.1 immature per adult. Since the validity of the age criteria used to determine age of blue-winged teal from wings has not yet been established for birds collected late in the season, the great drop in the age ratio could mean that errors were made in the interpretation of the wings collected late in the season. Louisiana bag checks, however, also showed a very low age ratio, 0.08 immatures per adult. Only 15 immatures were found among 200 bluewings aged and sexed by cloacal examination (Smith, 1960). This strongly suggests that the age determinations based on wings from bluewings taken late in the season were reliable. Age ratios in samples from Minnesota and Wisconsin were examined by time periods to see if changes occurred during the season (Table 44). In both States, age ratios on opening day were higher than they were during the remainder of the first week of the season. This tendency was more pronounced in Wisconsin than in Minnesota. After the first of the season, age ratios increased in both Minnesota and Wisconsin. This is reasonable, since adult blue-winged teal, particularly males, apparently migrate earlier than immatures. Sample sizes after the first week were very small, however.

When blue-winged teal age ratios are compared with those of other species (Table 32) it should be realized that, because of the very distorted sex ratio among adult bluewings, the age ratio tends to be inflated. Apparently, a large proportion of the adult male bluewings migrate out of the United States before the hunting season begins, and hence do not appear in the hunting kill. This results in an

average of over 3 adult females shot for each adult male. Had the adult age ratio been even in the Minnesota sample, for example, the age ratio would have been 1.02 immatures per adult instead of 1.57 and would have indicated poor production.

Pintail

Pintail age ratios are summarized on a regional basis in Table 45. In the northern tier of States, the age ratios were approximately 1.5 immatures per adult. Throughout the remainder of the Flyway, there appeared to be a distinct difference between the age composition of the kill east and west of the Mississippi River. In a sample of 91 wings from Iowa, Missouri, Arkansas, and Louisiana, the age ratio was 0.68 immatures per adult, in contrast to a ratio of 2.67 immatures per adult in a sample of 65 wings from Illinois, Ohio, Tennessee, and Mississippi. The samples from the States east of the Mississippi River and south of the northernmost tier of States had a higher age ratio than the samples from the northernmost tier of States. This suggests that the birds originated in a different production area, since it would be anticipated that if the same population of birds were being sampled, the age ratio would be lower in the southern States, where the season opened later. Bag checks at Magee Marsh, Ohio, indicated 4.51 immatures per adult in a sample of 490 birds. This high age ratio is similar to the 3.80 immatures per adult observed in the small wing-collection sample from Ohio. Bag checks in Louisiana showed 0.88 immature per adult in a sample of 180 birds (Smith, 1960), higher than the age ratio of 0.40 found in the wing-collection sample of 49 wings from Louisiana. This difference may have been because the bag checks were made in areas farther east than the areas of the wing-collection samples, which were mostly from the extreme southwestern portion of the State. Pintail age ratios from Minnesota were separated into two periods, the first week of the season and the remainder. There was a slight increase in the proportion of immatures in the bag during the later period (Table 46).

Because of the great importance of the pintail in the west, wing collections were made in the vicinity of several Federal refuges. Age ratios determined from these wings are summarized in Table 47. At Tule Lake Refuge, California, the age ratio was only 0.29 immature per adult, while farther south at Willows, California, the age ratio was 0.48 immature per adult. At Bear River Refuge, Utah, the age ratio was only 0.15 immature per adult. The fact that pintail age ratios were very low in the samples from these three places in the Pacific Flyway and also very low in the wing-collection samples from the westernmost States of the Mississippi Flyway suggests that pintail production was very poor during the 1959 breeding season.

Wood Duck

Data for wood ducks could be divided into two portions with different age ratios (Table 48). One portion was composed of data from the top two tiers of States, excluding Illinois. In the sample from this northern portion, the age ratio was 1.74 immatures per adult. In the combined sample for the other States, the age ratio was 0.96 immature per adult. It is not known whether these differences in age ratios reflect differences in production or changes in relative vulnerability of the two age groups. Furthermore, the sample sizes in each State are too small to estimate the age composition of the kill within a State with reasonable accuracy.

Lesser Scaup

In most States from which there were large samples, the age ratio of the lesser scaup was slightly greater than 1.0 immature per adult (Table 49). The average age ratio in samples from Minnesota, Wisconsin Michigan, Iowa, Illinois, Indiana, Ohio, and Missouri combined was 1.28 immatures per adult. In the small sample of 27 lesser scaup wings from Arkansas, Tennessee, Louisiana, Mississippi, and Alabama combined, the age ratio was 0.42 immature per adult. In bag-check samples from Louisiana there were 0.54 immature per adult among 573 birds (Smith, 1960).

Table 50 summarizes seasonal changes in age ratios of lesser scaup in the two States having the largest samples, Minnesota and Wisconsin. In samples from both States there was a pronounced progressive increase in the age ratio as the season progressed. In Minnesota, age ratios increased during the first 4 weeks of the season, then declined to a slightly lower level during the remainder of the season. Age ratios in Wisconsin samples increased sharply to a peak during the period October 21 through 27, then declined. Highest age ratios occurred at the time when scaup made up the largest portion of the kill in Minnesota and Wisconsin (Tables 17 and 18). A possible explanation for the lower age ratios early in the season is that non-breeding adults may precede the main flight, which then would include relatively more immatures.

Ring-necked Duck

Regional differences in ringneck age ratios are shown in Table 51. The highest age ratios were in the samples from the northernmost tier of States, (Minnesota, Wisconsin, and Michigan), 1.86 immatures per adult. In samples from Iowa, Illinois, and Ohio, the age ratio was 1.04 immatures per adult. In samples from the southern half of the Flyway, there was 0.73 immature per adult. Age ratios in the wing sample from Minnesota were examined for various periods during the season to determine if there was any change in the ratios as the season progressed. These data (Table 52) indicated that the ring-necked duck age ratio was 1.77 during the first 2 weeks of the season, but dropped to 0.55 immature per adult after October 20.

SEX RATIOS

The sex ratios among both immature and adult ducks of most of the species in the wing-collection samples are summarized in Table 53. The table shows the actual number of birds of each age and sex in the samples from each State, as well as both weighted and unweighted sex ratios for the Flyway as a whole. There were marked differences in the sex ratios of the various species. These differences will be discussed below under the species.

Mallard

Geographic differences in sex ratios of adult mallards are summarized in Table 54. Samples from most States contained more adult males than adult females. Females were slightly more numerous in the northern tier of States. Numbers of immature males and females were much more nearly equal. Only in Illinois did the sex ratio of immatures differ significantly from a 50:50 ratio. In Minnesota and Wisconsin a few more adult females than males were taken. In all other samples of adults, males predominated. The predominance of adult females in the samples from the northernmost States apparently resulted either from a greater vulnerability of females or from a greater availability in areas close to the breeding grounds. A predominance of females early in migration has been described for the black duck (Martin, 1960), and for the canvasback (Stewart, Geis and Evans, 1958, Geis 1959). The most unbalanced adult sex ratios were in the samples from Missouri, Illinois, Kentucky, Arkansas and Tennessee. Numbers of adult males and females were somewhat more nearly equal in the wing collections from Louisiana, Mississippi, and Alabama. Bag-check samples in Louisiana showed 91 males per 100 females in a sample of 212 adults (Smith, 1960), very similar to the proportion in the wing-collection samples. Sex ratios of adult mallards in the samples during the season are shown in Table 55. During the first 3 weeks of the season, the sexes either were equal or there were slightly more females. During the remainder of the season, there were considerably more males than females.

Changes in adult sex ratios also were examined in the data for the States (Table 56). In Minnesota, there were consistently more females until the last period (November 4-25) when the proportion of males increased. No seasonal change in sex ratios was apparent in either the Wisconsin or Michigan data. In the Iowa samples, adult females outnumbered adult males during the first week of the season, but the proportions changed during the second period until there were slightly more males than females. During the latter part of the season, November 3 through December 8, there were more than two and one-half times as many males as females. The sample sizes were very small in

all periods. In Illinois, there were marked fluctuations in the sex ratio during the season.

In Missouri, sample sex ratios of adult mallards remained rather uniform throughout the entire season, and there were no large fluctuations.

In Arkansas, marked changes in proportions of the sexes occurred during the season. During the period of November 30 through December 11, males predominated slightly. The proportion of males increased in the period of December 12 through January 1, until there were more than two adult males for each adult female. During the last week of the season, January 2 through 8, there appeared to be a reduction in the proportion of males.

In Tennessee, the proportion of males was somewhat lower early in the season than it was after December 7. However, sample sizes were very small.

In the small Louisiana sample of mallards, adult sex ratios suggested that adult females made up a greater part of the bag after December 15.

American Widgeon

Sex ratio data for adult American widgeon (Table 57) suggest differences between the eastern States and the western States. The differences are similar to those suggested by the age ratio data (Table 40). In the sample from the western States, numbers of males and females were approximately equal, while in the samples from the eastern States there were proportionally more males than females.

Green-winged Teal

Table 53 indicates that in the samples of adult green-winged teal, there usually were more females than males and that in the samples of immatures the sexes were essentially equal. Although the sample sizes were very small, the data suggest that there were more adult males than females in greenwing wintering areas such as Arkansas, but that in most other areas females predominated.

Blue-winged Teal

In samples of adult blue-winged teal, females greatly outnumbered males. Females also outnumbered males in the sample of immatures, but the difference was not so great. In Minnesota, the most important bluewing harvest area, numbers of immature males

and immature females were essentially equal. Adult male blue-winged teal apparently migrate from the Flyway before the hunting season opens. Because adult males are poorly represented in the bag, age ratios contain a bias that is not present among most other species.

Pintail

There were more males than females in the samples of immature pintails (Table 53). In the Minnesota sample, there were 45 males but only 22 females. This difference was a statistically significant departure at the 0.05 probability level from a 50:50 ratio. Although samples were very small, there apparently were regional differences in the sex ratios of adult pintails (Table 58). In the northern tier of States (Minnesota, Wisconsin, and Michigan), there were many more adult females than males in the sample. At the southern end of the Flyway, in Louisiana, the sample contained many more adult males than adult females. Throughout the remainder of the Flyway, the numbers of males and females were nearly equal. Smith (1960) also reported a larger proportion of adult males than females in a sample of 96 adult pintails in hunters' bags in Louisiana. The ratio was 317 males per 100 females.

Wood Duck

More males than females of both immature and adult wood ducks were found in the wing-collection sample. Because wood-duck age ratios (Table 48) were higher in the northern States than in the more southern States, sex ratio data for adults were grouped similarly to see if there were differences (Table 59). These data suggested little variation in wood-duck sex ratios between northern and southern States.

Lesser Scaup

Sex ratios of adult lesser scaup in the samples from Minnesota, Wisconsin, Michigan, and Ohio were markedly different from the ratios in the remainder of the Flyway (Table 60). The sex ratio was 96 adult males per 100 adult females in the northern States, while in the southern States it was 236 adult males per 100 adult females. In Louisiana bag checks made during the 1959-60 season, Smith (1960) found 247 adult males per 100 adult females in a sample of 371 birds.

KILL AND POPULATION ESTIMATES

Eventually, one of the most important uses for information on the age ratio in the kill will be in interpreting "Lincoln Index" population estimates. This subject is discussed in greater detail by Carney and Geis (1960). For example, an estimate of the population of a given species during the wintering period could be made from band recoveries from wintering-ground bandings and from results of the Mail Questionnaire Survey if the proportion of the kill consisting of adult birds were known. Unfortunately it has not been possible to examine the band-recovery data because of the fire in the Banding Office.

It has, however, been possible to make a rough estimate of the total kill from the banding information of the present study. Hunters were requested on the wing-collection envelope (Figure 1) to report the band number on the envelope if the duck wing enclosed was from a banded bird. A total of 101 bands from 10 species was reported on envelopes. Fish and Wildlife Service band numbers were reported for 46 of the 4,731 mallard wings returned. Weighted totals were 47.4 banded mallards among 4,554. A very rough estimate of the mallard kill can be made by using these figures with the figures for the total number of banded mallards normally reported to the Banding Office from the Mississippi Flyway. Since an average of approximately 3,300 banded mallards are reported from the Mississippi Flyway each year, the estimate can be made as shown in the equation below:

$$\frac{47.4}{4544} = \frac{3300}{X}$$

$$X = 316,354$$

If we assume that three banded birds are taken for every one reported, the estimate of the total kill would be 949,062. Although this estimate is considerably lower than the estimate made from the data of the Mail Questionnaire Survey, the two estimates are of the same general magnitude. The estimate from the Mail Questionnaire Survey was 1,279,578 in 1959-60 and considerably higher in previous years.

PROBLEMS INVOLVED IN SAMPLING THE DUCK KILL BY THE WING-COLLECTION TECHNIQUE

Geographic Distribution of the Sample

The wing collection showed that there were marked geographic differences in both age ratios and species composition. For best results, wings should be received from the same percentages of the kill in all areas, but such an ideal distribution of the sample is very difficult to attain. Several of the State samples in the 1959-60 survey did not have satisfactory geographic distribution

and results had to be interpreted accordingly. Methods for obtaining better distribution of the samples are being considered for use in future wing collections.

Seasonal Distribution of the Sample

It seems likely that hunters are less inclined to send in wings as the season progresses. Thus, the seasonal distribution of wings received probably does not exactly parallel the seasonal distribution of the total kill. It seems reasonable to assume, however, that if envelopes are supplied in the same quantity each year, and requests are made in the same way, the bias can be regarded as a constant, and indexes can be obtained that will be valid. Furthermore, if the season is broken into several periods, and the ratios from each period are properly weighted, then the bias should be decreased. It should be possible to weight these periodic samples from supplemental information on the true distribution of the kill. This supplemental information might come either from band-recovery data or from the results of a Mail Questionnaire Survey. No attempt was made to weight the data this year because of the unavailability of banding records. Seasonal distribution of samples from locker plants and hunters' bags is likely to be even more biased than the seasonal distribution of the wing-collection samples. Locker-plant examinations and bag checks are likely to be a function of the effort expended by biologists or cooperators and are not necessarily related to the true distribution of the kill. Age ratios calculated by combining all of the observations throughout the entire season are likely to be considerably in error because of the improper weight given to each period's sample. For example, the age ratios in the wing collection at the Central and Crane Lake Clubs, in Illinois, showed significant differences between periods, and 37 per cent of the sample was taken in two days, November 18 and 30. Since age ratios on those days were much lower than during the remainder of the season, there is a real question whether these low ratios should receive as much weight as they do when all the observations are simply added together to obtain the final age ratio.

Regardless of the sampling method, it may be necessary to devise some method of weighting the data from each period. If a suitable method for weighting the data cannot be found, then it seems necessary, at least, to follow a sampling procedure that will tend to distribute the sample in a constant manner throughout the season each year.

Differential Vulnerability

Age and sex groups of all species do not have the same probability of being taken by hunters (Bellrose, 1944, 1950; Geis, 1959). As a result, the age, sex, and species compostion in the hunting kill is not the same as the age, sex, and species composition in the waterfowl population. In order to use kill data for many purposes, it must be assumed that differential vulnerability is essentially constant each year. The extent to which this assumption is true is unknown at present. However, it is reasonable to conclude that variations between years in waterfowl production, for example, are probably much more important than variations between years in differential vulnerability. Assuming this to be true, the observed age ratios could serve as reliable indexes of production rates.

Information on the age, sex, and species composition of the hunting kill would be much more useful if it could be adjusted for differences in vulnerability, so that the actual age, sex, and species composition of the population prior to the hunting season could be determined.

Adjustment of age ratios probably is the most important aspect of this problem. In order to make this adjustment, it would be necessary to have an adequate sample of birds banded prior to the hunting season. Some banding was done prior to the 1959-60 hunting season (Table 61)*, but not enough to permit making adjustments in the wing-collection data. Data from this banding, however, do suggest several possibilities and problems. Mississippi Flyway recoveries from birds banded in Manitoba, Minnesota, and North Dakota suggested that immatures were approximately 1.4 times as vulnerable as adults to shooting. However, Mississippi Flyway recoveries from Saskatchewan bandings indicated that immatures were only 0.81 times as vulnerable as adults. The number of immatures banded in Saskatchewan was too small to permit a precise measure of the recovery rate of immatures, and therefore this result could have been due to chance. It is possible, however, that adults were more likely to be taken in the Mississippi Flyway than immatures because of the greater tendency of the immatures to be harvested on or near breeding grounds and early in migration. Many of the immature birds banded in Saskatchewan were harvested before they reached the Mississippi Flyway wintering grounds. Table 61 shows that for all areas combined immatures were more vulnerable than adults. It has been shown for the canvasback (Stewart, Geis and Evans, 1958) and for the black duck (Martin, 1960) that the kill of

* Due to complications resulting from the reconstruction of fire-damaged banding records, this information may be incomplete.

adults, particularly adult males, tends to be concentrated in wintering areas, whereas a greater proportion of the kill of immatures occurs farther north near the breeding grounds early in migration. If wings were collected throughout all the harvest areas, these differences in distribution of the kill would not affect the data seriously. However, when age ratios are based on only a portion of the total harvest area, it is necessary to have some method for weighting the various banded samples for the size of the kill they represent. It is hoped that more pre-season banding in the future will permit an evaluation of the feasibility of weighting kill data for differential vulnerability.

The location of the recoveries from flying mallards banded before the hunting season in Saskatchewan is shown in Figure 6. Only one of 31 recoveries in the Mississippi Flyway occurred in the northern tier of States. This suggests that birds coming from Saskatchewan, the principal drought area, tended to be taken in the southern and western portion of the Flyway and this would help explain the low age ratios among mallards taken in southern States.

Sampling Error

As used here, the term sampling error means the extent to which chance might cause a measurement based on a sample to differ from the true measurement in the population being sampled. It is very difficult to estimate the magnitude of sampling error of estimates based on the wing-collection data. First, the structure of the sample is complex. Second, there are several reasons why each wing received may not represent an independent random sample from all waterfowl taken in a specific area: (1) the sample of hunters was based on the lists obtained for the Mail Questionnaire Survey. Hunters' names were obtained from post offices selected at random, and as a result, the residences of these hunters tended to be clustered around the sample post offices rather than distributed at random throughout the State. The effect of this clustering is evident in Figures 3 and 5, and explains why the wing-collection samples in Arkansas and Louisiana were heavily concentrated in a small portion of the State; (2) the wing-collection samples are samples of the kill of a specific group of hunters rather than a random sample of the ducks taken by all hunters. It seems likely, for example, that the kill of a given hunter would not be a random sample of the species composition of the entire kill because of the particular areas in which a given person hunts; (3) the wings submitted by a certain hunter are taken on the day he hunts, rather than in a random manner during all days throughout the season.

CONCLUSIONS AND RECOMMENDATIONS

Results of the wing-collection pilot study reported here show that the wing-collection technique is a promising method for evaluating the factors affecting waterfowl production, understanding the status of waterfowl populations, and measuring the effect of regulations on the kill. The greatest significance of the data will come when information from different years can be compared. It is recommended that the wing collection be continued.

SUMMARY

The duck-wing collection in the Mississippi Flyway was undertaken as a trial to determine if it was a feasible method for measuring species composition, age ratios, and the sex ratios in the hunting kill. Letters were sent to approximately 8,000 hunters, who responded by sending about 10,000 wings. The response was judged to be very satisfactory. For analysis, the data from each State were weighted according to the relationship between the number of hunters to whom request letters were sent in the wing survey and the previous year's duck-stamp sales.

The wing data were used to measure the proportion of the reported kill in different parts of the waterfowl season and to show the proportion of the kill during different hours of the day and on different days of the week. In six northern States, a much higher proportion of the birds were killed early in the season than were killed early in the season in two southern States. The proportion of the kill early in the season, as estimated from data of the wing collection, was greater than the proportion estimated from the data of the Bureau's Mail Questionnaire Survey. The wing collection showed that the hourly distribution of the kill varied also. For example, hunters in several southern States reported a greater part of the kill in the morning than did those in any northern State.

Species composition of the kill also was determined from the wing-collection data. In the Flyway as a whole, the mallard made up almost half of the reported kill. The lesser scaup, which was the next most numerous, made up only about one-tenth of the kill. The combined daily bag limit of canvasbacks, redheads, and ruddy ducks in 1959-60 was one bird. These species made up only 2.1 per cent of the kill. The species composition determined from the wing collection was in general agreement with the composition determined from the Mail Questionnaire Survey, and the most important species in the kill were the same in both surveys. There were some differences in results of

the two surveys, however. Ring-necked ducks, gadwall, and American widgeon were reported in lesser proportion in the Mail Questionnaire Survey; whereas blue-winged teal, canvasbacks and, to a lesser degree, mallards were reported in greater proportion. The wing collection showed seasonal changes in the species composition of the kill in several States and so provided basic information on the timing of migration and the harvest.

Age ratios were lowest for the redhead, mallard, canvasback and pintail, in ascending order. Substantial proportions of the populations of these four species breed in the area that was most severely affected by drought during the 1959 breeding season. Certain species that breed to a greater extent outside the drought area had higher age ratios. For example, the black duck had an age ratio of 1.53 immatures per adult, in contrast to 0.77 for the mallard. Mallard age ratios differed between States and between differenct parts of the same State. For example, the age ratio was 1.20 in Minnesota, 2.13 in Wisconsin, and 2.56 in Michigan. This series thus shows an increase in the age ratios from west to east. There was a similar west-to-east increase in the next tier of Mississippi Flyway States, where the mallard age ratio was 0.53 in Iowa, 0.64 in Illinois, 1.46 in Indiana, and 1.55 in Ohio. One explanation for the higher age ratios in the eastern part of the Flyway is that mallards produced in the eastern and northern part of the breeding range were less affected by the drought than were those in the major breeding area in the Canadian Prairie Provinces. Age ratios in most States in the southern portion of the Mississippi Flyway were 0.51 or less.

Sex ratios for various species differed markedly among the States and among the periods of the season. Information on age and sex ratios was obtained from several sources in addition to the wing collection. Wings collected by refuge personnel near certain Federal refuges in both the Central and Pacific Flyways suggested that pintail age ratios were low in all major harvest areas. Bag checks made by State waterfowl biologists in the Mississippi Flyway showed a high age ratio among pintails in Ohio and a very low age ratio among blue-winged teal in Louisiana. These results were similar to those shown in the small wing-collection samples from the same areas.

Problems of interpreting data from the wing collection concern the geographic distribution of the sample, differential vulnerability of the various age and sex groups, sampling error, and weighting. Results of the wing survey in the Mississippi Flyway were so satisfactory that the wing-collection technique is judged a promising research tool.

Literature Cited

Bellrose, F. C.
1944. Duck populations and kill, an evaluation of some waterfowl regulations in Illinois. Ill. Nat. Hist. Surv. Bul. No. 23 (2): 327-372.

_____, and Elizabeth Brown Chase.
1950. Population losses in the mallard, black duck and blue-winged teal. Ill. Nat. Hist. Surv. Biol. Notes No. 22 (2):1-27.

Blouch, R. I., and G.A. Ammann.
1952. Collection of biological material from hunters by use of postpaid envelopes. Mich. Dept. Cons. Unpubl. Game Div. Rept. 2072: 1-6.

Carney, Samuel M., and Aelred D. Geis.
1960. Mallard age and sex determination from wings. J. Wildl. Mgmt., 24 (4): 372-381.

Dow, S. A., Jr.
1954. Anatomical specimen collection by prepaid envelope. 8th Ann. Conf., S. E. Assoc. Game and Fish Comm., 6 pp.

Geis, Aelred D.
1959. Annual and shooting mortality estimates for the canvasback. J. Wildl. Mgmt.,23 (3): 253-261.

_____, and Earl L. Atwood.
1959. Reliability of the identification of bagged waterfowl in letters reporting band recoveries. Unpubl. Ms. Filed at Patuxent Wildlife Research Center, Laurel, Maryland.

Hansen, Harry (Editor)
1959. The 1959 World Almanac and Book of Facts, New York World Telegram Corporation, N. Y. 896 pp.

Martin, Fant W.
1960. Analysis of black duck bandings--A progress report. Proceed. N. W. Wildl. Conf. 6 pp.

Smith, Morton H.
1960. Duck age ratios--Louisiana. Louisiana Dept. Wild Life and Fisheries Comm.,5 pp. mimeo.

Stewart, Robert E., Aelred D. Geis, and Charles D. Evans.
1958. Distribution of populations and hunting kill of the canvasback. J. Wildl. Mgmt.,22 (4):333-370.

Table 1. Wings Received from Hunters in the Mississippi Flyway in Response to Request Letters

Species	Minn.	Wisc.	Mich.	Ia.	Ill.	Ind.	Ohio
Mallard	1146	362	159	193	807	35	137
Mallard x Black 2/	3	12	2	--	4	1	2
Black	105	80	118	3	42	7	56
Mottled 3/	--	--	--	--	--	--	--
Gadwall	122	2	3	12	24	--	--
A. Widgeon	178	64	54	24	43	4	27
G. W. Teal	371	112	73	56	64	1	62
B. W. Teal	372	150	47	7	11	--	12
Shoveler	25	4	5	7	16	2	2
Pintail	108	38	42	18	24	--	24
Wood Duck	84	79	26	11	45	6	126
Red Head	51	11	42	4	4	--	8
Canvasback	14	13	19	--	9	--	3
G. Scaup	36	14	61	3	8	--	1
L. Scaup	616	162	101	33	62	1	23
Ringneck	324	83	16	10	27	--	16
Goldeneye	32	12	28	4	9	--	5
Bufflehead	42	29	46	2	5	--	10
Old Squaw	1	--	1	--	--	--	--
A. Scoter	2	--	3	--	1	--	4
W. W. Scoter	3	--	4	1	--	--	--
Surf Scoter	--	--	--	--	--	--	--
Ruddy	3	10	2	--	1	--	5
A. Merganser	--	1	--	--	1	--	1
R. B. Merganser	2	2	6	--	1	1	5
H. Merganser	13	10	12	3	7	--	5
C. Goose (large)	2	3	1	--	1	--	--
C. Goose (small)	10	1	--	--	--	--	--
Blue	4	5	2	--	1	--	2
Snow	1	1	--	1	--	--	1
Coot	5	15	2	--	--	--	2
Grebe	--	--	2	--	1	--	--
Pheasant	--	--	1	--	--	--	--
Unknown	8	2	--	--	1	--	2
Total	3683	1277	878	392	1219	58	541

Continued --

Table 1. Wings Received from Hunters in the Mississippi Flyway in Response to Request Letters (Cont'd).

Species	Mo.	Ky.	Ark. 1/	Tenn.	La. 1/	Miss.	Ala.
Mallard	543	12	971	160	147	42	17
Mallard x Black 2/	3	--	1	--	1	--	--
Black	5	5	12	13	4	2	4
Mottled 3/	--	--	--	--	3	--	--
Gadwall	15	--	11	8	4	2	4
A. Widgeon	30	--	9	4	4	4	3
G. W. Teal	55	--	22	4	11	4	2
B. W. Teal	1	--	--	1	28	--	--
Shoveler	4	--	5	2	7	--	1
Pintail	19	--	5	4	49	2	--
Wood Duck	15	--	10	5	14	18	9
Red Head	1	--	--	--	--	1	1
Canvasback	1	2	--	1	2	1	1
G. Scaup	--	--	--	--	--	--	3
L. Scaup	25	--	1	4	13	1	8
Ringneck	11	--	7	1	11	7	24
Goldeneye	1	--	2	--	1	--	--
Bufflehead	3	--	--	--	--	1	1
Old Squaw	--	--	--	--	--	--	--
A. Scoter	--	--	--	--	--	--	--
W. W. Scoter	--	--	--	--	--	--	--
Surf Scoter	--	--	--	--	--	--	--
Ruddy	1	--	--	--	--		--
A. Merganser	1	--	--	--	--	--	--
R. B. Merganser	1	--	--	--	--	--	--
H. Merganser	4	--	1	1	--	1	--
C. Goose (large)	--	--	--	--	--	--	--
C. Goose (small)	--	--	--	--	--	--	--
Blue	1	--	--	--	--	--	--
Snow	2	--	--	--	--	--	--
Coot	--	--	--	--	--	--	--
Grebe	--	--	--	--	--	--	--
Pheasant	--	--	--	--	--	--	--
Unknown	--	--	4	1	2	1	--
Total	742	19	1061	209	301	87	78

Grand Total: 10545

1/ Samples were not geographically representative
2/ Separation from both mallards and blacks was somewhat arbitrary
3/ Three mottled ducks are included in the Louisiana sample; others may have been present there and in Alabama and Mississippi

Table 2. Wings Received from Outside the Mississippi Flyway in Response to Request Letters

Species	Cal.	Colo.	Kan.	Ont.	Sask.	W.Va.	Unknown
Mallard	--	--	3	12	6	3	--
Mallard x Black	--	--	--	1	--	--	--
Black	--	--	--	4	--	9	--
G.W. Teal	--	2	--	--	--	--	1
Redhead	--	--	--	1	--	--	--
Canvasback	--	--	--	1	--	--	--
G. Scaup	--	--	--	3	--	--	--
L. Scaup	1	--	--	13	--	1	--
Ringneck	--	--	--	--	--	--	2
Goldeneye	--	1	--	--	--	--	--
Surf Scoter	--	--	--	1	--	--	--
Total	1	3	3	36	6	13	3

Grand Total: 65

Table 3. Wings Received from Volunteers in the Mississippi Flyway

Species	Illinois	Iowa	Minnesota	Missouri	Tennessee
Mallard	7	--	12	3	24
Black	1	--	--	--	21
Gadwall	--	--	1	--	2
Am. Widgeon	--	--	3	--	8
G.W. Teal	--	--	--	--	4
Pintail	2	--	--	--	1
Wood Duck	--	--	--	--	5
Redhead	--	--	2	--	--
G. Scaup	--	--	1	--	--
L. Scaup	--	--	15	--	--
Ringneck	--	--	1	--	--
Goldeneye	--	4	--	--	--
Total	10	4	35	3	65

Grand Total: 117

Table 4. Scientific Names of Species Mentioned in This Report (Fifth Edition A.O.U. Check-List).

Ducks and Geese

Dabbling Ducks	Anatinae
Mallard	Anas platyrhynchos
Black Duck	Anas rubripes
Mottled Duck	Anas fulvigula
Gadwall	Anas strepera
Pintail	Anas acuta
Green-winged Teal	Anas carolinensis
Blue-winged Teal	Anas discors
American Widgeon	Mareca americana
Shoveler	Spatula clypeata
Wood Duck	Aix sponsa
Diving Ducks	Aythyinae
Redhead	Aythya americana
Ring-necked duck	Aythya collaris
Canvasback	Aythya valisineria
Greater Scaup	Aythya marila
Lesser Scaup	Aythya affinis
Common Goldeneye	Bucephala clangula
Barrow's Goldeneye	Bucephala islandica
Bufflehead	Bucephala albeola
Oldsquaw	Clangula hyemalis

Table 4. (Cont.)

White-winged Scoter . . . . . Melanitta deglandi

Surf Scoter . . . . . Melanitta perspicillata

Common Scoter . . . . . Oidemia nigra

Ruddy Ducks . . . . . Oxyurinae

Ruddy Duck . . . . . Oxyura jamaicensis

Mergansers . . . . . Merginae

Hooded Merganser . . . . . Lophodytes cucullatus

Common Merganser . . . . . Mergus merganser

Red-breasted Merganser . . . . . Mergus serrator

Geese . . . . . Anserinae

Canada Goose . . . . . Branta canadensis

Snow Goose . . . . . Chen hyperborea

Blue Goose . . . . . Chen caerulescens

Other Species

Pied-billed Grebe . . . . . Podilymlus podiceps

American Coot . . . . . Fulica americana

Ring-necked Pheasant . . . . . Phasianus colchicus

Table 5. Calculation of Weighting Factors

State	No. Hunters Contacted	% of Total Contacts (1)	1958-59 Duck Stamp Sales	% of Total Sales (2)	Weighting factor (2 ÷ 1)
Alabama	73	0.91	16,291	1.75	1.92
Arkansas	552	6.90	59,218	6.36	0.92
Illinois	939	11.74	108,456	11.64	0.99
Indiana	133	1.66	41,450	4.45	2.68
Iowa	267	3.34	54,816	5.88	1.76
Kentucky	61	0.76	17,174	1.84	2.42
Louisiana	497	6.21	91,803	9.85	1.59
Michigan	743	9.29	110,260	11.84	1.27
Minnesota	1810	22.63	147,895	15.88	0.70
Mississippi	154	1.93	19,442	2.09	1.08
Missouri	769	9.62	73,150	7.85	0.82
Ohio	710	8.88	43,003	4.62	0.52
Tennessee	222	2.78	38,730	4.16	1.49
Wisconsin	1066	13.33	109,856	11.79	0.88
Total	7997	99.98	931,544	100.00	

Table 6. Response Rates

Wisconsin

Duck Kill 1/	Hunters Contacted	Respondents	Wings Rec'd	% Hunters Responding	Wings/ Respondent	Wings/ Contact
1 - 5	586	112	397	19.1	3.5	0.7
6 - 10	259	68	284	26.3	4.2	1.1
11- 15	88	25	102	28.4	4.1	1.2
16- 20	52	14	75	26.9	5.4	1.4
21- +	81	39	417	48.1	10.7	5.1
Total or Average	1066	258	1275	24.2	4.9	1.2

Michigan

1 - 5	438	61	197	13.9	3.2	0.4
6 - 10	164	47	220	26.2	5.1	1.3
11- 15	52	15	116	28.8	7.7	2.2
16- 20	38	13	95	34.2	7.3	2.5
21- +	51	27	281	52.9	10.4	5.5
Total or Average	743	163	909	21.9	5.6	1.2

Illinois

1 - 5	494	73	272	14.8	3.7	0.6
6 - 10	171	44	183	23.4	4.2	1.1
11- 15	97	27	116	27.8	4.3	1.2
16- 20	44	22	146	50.0	6.6	3.3
21- +	133	55	518	41.4	9.4	3.9
Total or Average	939	221	1235	23.5	5.6	1.3

Arkansas

1 - 5	143	14	47	9.8	3.4	0.3
6 - 10	112	18	84	16.1	4.7	0.8
11- 15	70	19	89	27.1	4.7	1.3
16- 20	65	17	139	26.2	8.2	2.1
21- +	162	60	696	37.0	11.6	4.3
Total or Average	552	128	1055	23.2	8.3	1.9

1/ As reported on the 1957 or 1958 Mail Questionnaire Survey

Table 7. Effect of Follow-up Letter on Response Rates

Received Follow-up Letter	Contacts	Percentages of Contacts Responding			Percentages of Wings Received		Total Number Wings
		Before Letter	After Letter	Total	Before Letter	After Letter	
			Michigan				
yes	371	15.6	12.4	21.6	50.4	50.6	416
no	372	16.1	09.9	20.7	63.9	36.1	442
			Illinois				
yes	469	23.7	11.5	27.7	73.4	26.6	723
no	470	15.5	6.0	18.3	73.7	26.3	446
			Arkansas				
yes	274	16.8	13.1	23.7	47.1	52.9	616
no	273	19.8	09.5	22.7	66.9	33.1	431

Table 8. Percentage of Respondents Who Returned All the Envelopes They Received Originally.[1]

Envelopes Received	Arkansas		Illinois		Michigan		Wisconsin		States Combined	
	%	S.S.[2]	%	S.S.	%	S.S.	%	S.S.	Percentage	Total
4-8	29	14	36	72	15	59	12	112	16.5	257
9-13	0	18	3	40	7	46	7	68	5.1	172
14-18	5	19	4	27	7	15	4	25	4.7	86
19-23	6	17	0	22	0	11	0	14	1.5	64
25	8	60	5	58	7	27	12	40	8.3	185
4-25	9	128	14	219	9	158	9	259	10.6	764

1/ Includes some hunters who requested more envelopes.

2/ Sample size.

Table 9. Use of Supplemental Envelopes by 27 Duck Hunters.

State	Hunter Number	Original Shipment	Supplemental Shipment	Total Envelopes	Total Envelopes Returned
Wisconsin	569	5	10	15	11
	558	7	10	17	14
	884	7	15	22	9
	941	4	10	14	2
	828	6	10	16	6
	827	7	10	17	7
	687	4	10	14	5
	777	25	20[1]	45	47
	683	25	20[1]	45	32
Michigan	159	11	50	61	4
	393	12	10	22	14
	283	25	10	35	11
	133	11	10	21	8
Illinois	521	11	10	21	15
	527	8	10	18	12
	525	6	10	16	8
	747	7	10	17	6
	861	6	10	16	7
	718	5	10	15	7
	286	7	10	17	7
	556	11	10	21	7
	432	4	10	14	6
	565	25	10	35	36
Arkansas	113	25	210[1]	235	171
	174	25	10	35	32
	176	25	75	100	32
	259	6	10	16	6

1/ 2 supplemental shipments

Table 10. Distribution of the Duck Kill Within the 1959-60 Season as Indicated by the Mail Questionnaire Survey and the Mail Wing Collection.

Period	Minnesota		Wisconsin		Michigan	
	Questionnaire Survey	Wing Collection	Questionnaire Survey	Wing Collection	Questionnaire Survey	Wing Collection
Oct. 7-13	38.0%	62.0%	27.6%	52.4%	28.2%	37.0%
14-20	20.2	17.3	18.0	21.9	17.9	17.2
21-27	16.7	11.0	16.4	10.6	15.5	12.5
Oct.28-Nov. 3	11.5	5.8	12.8	7.1	13.7	12.2
Nov. 4-10	7.1	3.0	12.2	5.5	14.7	11.5
Nov.11-25*	6.5	0.9	12.9	2.4	10.0	9.7
Total	100.0	100.0	99.9	99.9	100.0	100.1
Sample Size	5527	3669	9546	1267	5809	863

* In Michigan this period was Nov. 11-15

Table 10. (Cont.)

Iowa			Illinois			Ohio		
Period	Questionnaire Survey	Wing Collection	Period	Questionnaire Survey	Wing Collection	Period	Questionnaire Survey	Wing Collection
Oct. 20-26	26.3%	52.8%	Oct. 30-Nov. 5	20.9%	36.4%	Oct.16-22	26.8%	42.3%
Oct. 27-Nov. 2	17.9	17.5	Nov. 6-12	21.1	28.6	Oct.23-29	16.4	17.8
Nov. 3 -9	22.0	23.4	Nov.13-19	18.6	17.8	Oct.30-Nov. 5	17.3	17.2
Nov.10-16	15.8	4.8	Nov.20-26	17.0	9.0	Nov. 6-12	16.1	12.8
Nov.17-23	8.9	0.0	Nov. 27-Dec. 3	11.7	6.1	Nov.13-19	12.1	8.2
Nov.24-Dec. 8	9.0	1.4	Dec. 4-8	10.8	2.2	Nov.20-24	11.2	1.7
Total	99.9	99.9		100.1	100.1		99.9	100.0
Sample Size	5235	371		3426	1170		2562	539

Table 10. (Cont.)

Missouri			Arkansas			Louisiana		
Period	Questionnaire Survey	Wing Collection	Period	Questionnaire Survey	Wing Collection	Period	Questionnaire Survey	Wing Collection
Nov. 6-12	28.2%	49.7%	Nov.30-Dec. 6	27.8%	38.5%	Nov.26-Dec. 2	23.0%	27.6%
Nov.13-19	17.0	15.8	Dec. 7-Dec.13	15.8	12.1	Dec. 3-9	15.0	8.6
Nov.20-26	15.9	11.1	Dec.14-20	14.2	19.8	Dec.10-16	14.8	14.0
Nov.27-Dec. 3	11.4	7.2	Dec.21-27	15.4	13.7	Dec.17-23	15.6	18.9
Dec. 4-10	13.2	6.9	Dec.28-Jan.3	15.7	10.8	Dec.24-30	16.3	12.6
Dec.11-25	14.3	9.3	Jan. 4-8	11.2	5.0	Dec.31-Jan. 4	15.3	18.3
Total	100.0	100.0		100.1	99.9		100.0	100.0
Sample Size	4519	739		6625	1051		5945	301

Table 11. Percentage Distribution of Duck Kill by Days of the Week (Excluding Opening Day)

State	S	M	T	W	T	F	S	Number of Wings
Minn.	24.0	6.5	4.5	5.4[1]	18.8	13.5	27.3	3009
Wisc.	22.5	8.0	6.0	7.7[1]	15.8	15.5	24.5	1124
Mich.	22.5	9.5	7.6	6.9[1]	14.4	13.2	25.9	731
Iowa	20.0	3.9	4.7[1]	12.3	17.9	14.0	27.2	307
Ill.	20.4	10.6	9.1	8.2	9.8	16.0[1]	26.0	1068
Ind.	0.0[3]	9.3	20.0	17.3	6.7	10.6[1]	36.0	48
Ohio	0.4[3]	17.4	14.6	13.5	7.8	11.1[1]	35.2	468
Mo.	19.6	11.0	6.0	12.5	12.9	11.4[1]	26.6	631
Ky.	0.0	0.0[2]	0.0	21.2	15.2	45.4	18.1	19
Ark.	17.5	8.2[1]	18.3	14.3	17.2	9.8	14.8	942
Tenn.	14.4	12.1[1]	12.4	17.3	10.7	12.9	20.2	207
La.	9.5	6.2	15.3	12.8	11.1[1]	21.0	24.1	284
Miss.	20.6	9.3	13.4	13.4	19.6	7.2[1]	16.5	78
Ala.	10.6	4.3[2]	8.5	2.1	25.5	19.2	29.8	78

[1]Day of week from which opening day was subtracted.

[2]No wings from opening day.

[3]Sunday closed.

Table 12. Comparisons of Daily Percentages of Kill (excluding Sunday) in Ohio, Illinois, and Michigan[1]

	S	M	T	W	T	F	S	Total	Sample Size
Ohio	X	17.4	14.6	13.6	7.8	11.2	35.3	99.9	466
Illinois	X	13.3	11.5	10.3	12.3	20.1	32.6	100.1	837
Michigan	X	12.2	9.8	8.9	18.6	17.1	33.4	100.0	560

[1] Opening day kill omitted

Table 13. Distribution of the Kill Within the Day.

State	Type	Before sunrise	Hours after sunrise 0-1	1-2	2-3	3-4	4-5	Mid period[1] act.	adj.	Hours before sunset 4-3	3-2	2-1	1-0	After sunset	Total %	Sample size
Minn.	Dabbler	0.4	15.0	10.8	7.4	6.9	4.8	18.7	(8.6)	9.4	8.6	10.6	7.3	0.2	100.1	2136
	Diver	1.0	19.8	19.9	9.8	9.1	4.0	5.6	(3.0)	5.7	6.9	11.3	6.5	0.6	100.2	1005
	Total	0.6	16.5	13.7	8.1	7.6	4.5	14.5	(7.3)	8.2	8.0	10.8	7.0	0.4	99.9	3141
Total excl. opening day		0.7	20.2	16.7	9.9	9.0	5.5	6.5	(3.5)	5.3	7.7	11.2	7.4	-	100.1	2565
Wisc.	Dabbler	1.0	23.5	14.2	7.5	7.4	3.4	11.3	(5.4)	8.2	7.7	9.6	5.8	0.2	99.8	813
	Diver	0.7	31.8	20.4	8.7	6.6	3.1	5.9	(3.2)	3.5	5.2	11.4	2.8	-	100.1	289
	Total	0.9	25.7	15.9	7.8	7.2	3.4	9.9	(4.8)	7.0	7.1	10.1	5.0	0.2	100.2	1102
Total excl. opening day		1.0	28.8	17.8	8.7	8.0	3.7	5.4	(2.7)	5.0	6.0	10.0	5.4	0.1	99.9	983
Mich.	Dabbler	0.9	12.7	9.2	6.7	6.9	3.9	18.2	(9.6)	7.1	10.7	13.7	9.7	0.4	100.1	466
	Diver	-	12.7	20.5	10.7	14.3	6.6	9.8	(6.0)	6.1	7.0	9.4	2.9	-	100.0	244
	Total	0.6	12.7	13.1	8.0	9.4	4.8	15.4	(7.7)	6.8	9.4	12.3	7.3	0.3	100.1	710
Total excl. opening day		0.7	14.9	15.4	9.3	11.1	5.6	7.5	(3.0)	5.8	9.6	12.3	7.5	0.3	100.0	603
Iowa	Dabbler	0.3	22.8	14.5	6.8	4.0	3.4	13.5	(9.1)	5.8	11.7	10.2	6.8	0.3	100.1	325
	Diver	5.2	25.9	31.0	10.3	3.4	5.2	10.3	(7.1)	-	1.7	5.2	1.7	-	99.9	58
	Total	1.0	23.2	17.0	7.3	3.9	3.7	13.1	(8.8)	5.0	10.2	9.4	6.0	0.3	100.1	365
Total excl. opening day		1.2	27.6	20.1	8.7	4.6	4.3	5.9	(4.4)	3.5	8.0	9.9	5.9	0.3	100.0	323
Ill.	Dabbler	0.3	14.7	16.2	14.0	11.0	6.5	5.9	(4.3)	7.5	7.9	9.6	6.2	0.1	99.9	962
	Diver	-	17.9	17.1	17.9	24.8	5.1	2.6	(1.8)	3.4	5.1	5.1	0.9	-	99.9	117
	Total	0.3	15.0	16.3	14.5	12.5	6.4	5.6	(4.0)	7.0	7.6	9.1	5.7	0.1	100.1	1079
Total excl. opening day		0.3	16.3	17.6	15.7	13.6	6.9	3.4	(2.7)	5.4	6.0	8.7	5.9	0.1	99.9	994
Ind.	Total	-	11.7	31.4	3.9	-	-	2.0	(2.0)	7.8	15.7	5.9	13.7	7.8	99.9	51
Total excl. opening day		-	14.0	37.2	4.7	-	-	2.3	(2.3)	9.3	11.6	4.7	9.3	7.0	100.1	43

Table 13. Distribution of the Kill Within the Day (Cont'd).

State	Type	Before sunrise	Hours after sunrise 0-1	1-2	2-3	3-4	4-5	Mid period[1] act.	adj.	Hours before sunset 4-3	3-2	2-1	1-0	After sunset	Total %	Sample size
Ohio	Dabbler	0.8	16.5	17.5	9.4	8.1	6.3	10.7	(6.1)	6.6	6.9	9.6	7.6	-	100.0	394
	Diver	-	20.3	23.4	17.2	12.5	6.3	4.7	(4.7)	10.9	3.1	1.6	-	-	100.0	64
	Total	0.6	17.0	18.3	10.5	8.7	6.3	9.8	(5.9)	7.2	6.3	8.5	6.5	-	99.7	458
Total excl. opening day		0.8	19.3	20.8	12.2	10.2	7.4	5.8	(4.0)	6.1	4.3	7.1	6.1	-	100.1	394
Mo.	Dabbler	0.3	10.7	11.7	10.6	11.9	3.1	7.1	(6.2)	5.9	12.4	17.3	8.9	-	99.9	606
	Diver	-	36.8	13.2	5.3	-	7.9	13.2	(10.8)	5.3	7.9	7.9	2.6	-	100.1	38
	Total	0.3	12.3	11.8	10.2	11.2	3.4	7.5	(6.4)	5.9	12.1	16.7	8.5	-	99.9	644
Total excl. opening day		0.4	14.1	13.8	11.8	12.9	4.0	3.1	(3.1)	2.5	11.8	16.1	9.6	-	100.1	552
Ky.	Total	-	21.4	28.6	14.3	14.3	14.3	-	(-)	-	-	7.1	-	-	100.0	14
No opening day		-	-	-	-	-	-	-	(-)	-	-	-	-	-	-	-
Ark.	Total	4.8	37.3	17.3	11.1	6.7	2.1	1.4	(1.5)	2.8	4.5	6.9	4.7	0.3	99.9	866
Total excl. opening day		5.3	40.9	19.0	12.2	7.4	2.3	0.5	(0.6)	1.4	2.4	3.9	4.1	0.4	99.8	789
Tenn.	Total	1.6	18.9	12.2	13.0	8.7	5.5	5.5	(5.5)	8.7	7.1	7.5	9.1	2.4	100.2	254
Total excl. opening day		1.7	20.5	12.0	13.7	9.4	6.0	5.6	(5.6)	7.7	6.0	7.3	7.7	2.6	100.2	234
La.	Dabbler	2.0	34.3	26.2	19.4	3.6	2.8	0.8	(0.8)	0.8	2.4	3.6	4.0	-	99.9	248
	Diver	-	52.0	16.0	-	16.0	4.0	-	(-)	12.0	-	-	-	-	100.0	25
	Total	1.8	35.8	25.3	17.6	4.8	2.9	0.7	(0.7)	1.8	2.2	3.3	3.7	-	99.9	273
Total excl. opening day		1.9	37.4	26.3	18.3	5.0	3.1	0.8	(0.8)	0.8	0.8	2.7	3.1	-	100.2	262
Miss.	Total	13.4	19.4	13.4	6.0	4.5	-	-	(-)	1.5	1.5	16.4	17.9	6.0	100.0	67
Total excl. opening day		15.3	22.0	15.3	6.8	5.1	-	-	(-)	1.7	1.7	15.3	11.9	5.1	100.2	59

Table 13. Distribution of the Kill Within the Day (Cont'd).

State	Type	Before sunrise	Hours after sunrise 0-1	1-2	2-3	3-4	4-5	Mid period[1] act.	adj.	Hours before sunset 4-3	3-2	2-1	1-0	After sunset	Total %	Sample size
Ala.	Dabbler	3.0	30.3	18.2	9.1	-	6.1	6.1	(6.1)	3.0	6.1	9.1	9.1	-	100.1	33
	Diver	10.5	18.4	18.4	5.3	5.3	7.9	-	(-)	2.6	2.6	18.4	10.5	-	99.9	38
	Total	7.0	23.9	18.3	7.0	2.8	7.0	2.8	(2.8)	2.8	4.2	14.1	9.9	-	99.8	71

1. The mid period was of variable length. The percentage under "act" (actual) relate to the actual kill in this period, while percentage under "adj" (adjusted) relate to the kill expressed as kill per hour so that it is comparable to other values in the table based on hourly intervals.

Table 14. Comparison of Morning and Afternoon Kills[1]

	Percentages		Sample Size
	Morning	Afternoon	
Minnesota	65	35	2831
Michigan	60	40	685
Wisconsin	71	29	1084
Iowa	68	32	308
Illinois	72	28	1022
Ohio	68	32	469
Indiana	56	44	45
Missouri	58	42	606
Arkansas	87	13	895
Kentucky	95	05	19
Tennessee	75	25	193
Louisiana	87	13	288
Mississippi	63	37	64
Alabama	71	29	78

1/ Opening day excluded.

Table 15. Comparison of Hunting Success in Three States as Indicated by the Relative Number of Days on Which Various Size Bags were Reported[1]

Kill	Minnesota		Michigan		Arkansas	
	Hunter Days	%	Hunter Days	%	Hunter Days	%
0	1560	44.3	4007	62.8	2743	56.1
1	509	14.5	929	14.6	586	12.0
2	527	15.0	676	10.6	479	9.8
3	862	24.5	324	5.1	317	6.5
4	60[2]	1.7[2]	447	7.0	764	15.6
Total	3518	100.0	6381	100.1	4889	100.0

1 In the 1959-60 mail questionnaire kill survey

2 The bag limit was 3 ducks in Minnesota

Table 16. Species Composition of the Duck Kill in the Mississippi Flyway as Shown by the 1959 Wing Collection.[1]

	Minn.	Wisc.	Mich.	Iowa	Ill.	Ind.	Ohio	Mo.
Mallard	31.3	28.9	18.3	49.4	66.5	60.3	25.6	73.5
Black[2]	2.9	6.4	13.6	0.8	3.4	12.1	10.4	0.7
Black x Mallard	0.1	1.0	0.2	0.0	0.3	1.7	0.4	0.4
Gadwall	3.3	0.2	0.3	3.1	2.0	0.0	0.0	2.0
Am. Widgeon	4.9	5.1	6.2	6.1	3.5	6.9	5.0	4.1
Green-winged Teal	10.1	8.9	8.4	14.3	5.3	1.7	11.6	7.4
Blue-winged Teal	10.2	12.0	5.4	1.8	0.9	0.0	2.2	0.1
Shoveler	0.7	0.3	0.6	1.8	1.3	3.4	0.4	0.5
Pintail	3.0	3.0	4.8	4.6	2.0	0.0	4.5	2.6
Wood Duck	2.3	6.3	3.0	2.8	3.7	10.3	23.5	2.0
Redhead	1.4	0.9	4.8	1.0	0.3	0.0	1.5	0.1
Canvasback	0.4	1.0	2.2	0.0	0.7	0.0	0.6	0.1
Greater Scaup	1.0	1.1	7.0	0.8	0.7	0.0	0.2	0.0
Lesser Scaup	16.8	12.9	11.6	8.4	5.1	1.7	4.3	3.4
Ringneck	8.8	6.6	1.8	2.6	2.2	0.0	3.0	1.5
Goldeneye	0.9	1.0	3.2	1.0	0.7	0.0	0.9	0.1
Bufflehead	1.1	2.3	5.3	0.5	0.4	0.0	1.9	0.4
Ruddy	0.1	0.8	0.2	0.0	0.1	0.0	0.9	0.1
Common Merganser	0.0	0.1	0.0	0.0	0.1	0.0	0.2	0.1
Red-breasted Merganser	0.1	0.2	0.7	0.0	0.1	1.7	0.9	0.1
Hooded Merganser	0.4	0.8	1.4	0.8	0.6	0.0	0.9	0.5
Old Squaw	0.03	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Common Scoter	0.1	0.0	0.3	0.0	0.1	0.0	0.7	0.0
White-winged Scoter	0.1	0.0	0.5	0.3	0.0	0.0	0.0	0.0
Unknown	0.2	0.2	0.0	0.0	0.1	0.0	0.4	0.0
Total	100.2	100.0	99.9	100.1	100.1	99.8	100.0	99.7
Sample size	3661	1252	870	391	1216	58	536	739

Table 16. Species Composition of the Duck Kill in the Mississippi Flyway as Shown by the 1959 Wing Collection (Cont'd).[1]

	Ky.	Ark.	Tenn.	La.	Miss.	Ala.	Entire Flyway (weighted)
Mallard	63.2	91.5	76.6	48.8	48.3	21.8	46.6
Black[2]	26.3	1.1	6.2	2.3	2.3	5.1	4.6
Black x Mallard	0.0	0.1	0.0	0.3	0.0	0.0	0.3
Gadwall	0.0	1.0	3.8	1.3	2.3	5.1	1.9
Am. Widgeon	0.0	0.8	1.9	1.3	4.6	3.8	4.2
Green-winged Teal	0.0	2.1	1.9	3.7	4.6	2.6	7.6
Blue-winged Teal	0.0	0.0	0.5	9.3	0.0	0.0	5.4
Shoveler	0.0	0.5	1.0	2.3	0.0	1.3	0.9
Pintail	0.0	0.5	1.9	16.3	2.3	0.0	3.4
Wood Duck	0.0	0.9	2.4	4.7	20.7	11.5	4.0
Redhead	0.0	0.0	0.0	0.0	1.1	1.3	1.2
Canvasback	10.5	0.0	0.5	0.7	1.1	1.3	0.7
Greater Scaup	0.0	0.0	0.0	0.0	0.0	3.8	1.4
Lesser Scaup	0.0	0.1	1.9	4.3	1.1	10.3	9.2
Ringneck	0.0	0.7	0.5	3.7	8.0	30.8	4.7
Goldeneye	0.0	0.2	0.0	0.3	0.0	0.0	0.9
Bufflehead	0.0	0.0	0.0	0.0	1.1	1.3	1.4
Ruddy	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Common Merganser	0.0	0.0	0.0	0.0	0.0	0.0	0.03
Red-breasted Merganser	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Hooded Merganser	0.0	0.1	0.5	0.0	1.1	0.0	0.6
Old Squaw	0.0	0.0	0.0	0.0	0.0	0.0	0.02
Common Scoter	0.0	0.0	0.0	0.0	0.0	0.0	0.1
White-winged Scoter	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Unknown	0.0	0.4	0.5	0.7	1.1	0.0	0.2
Total	100.0	100.0	100.1	100.0	99.7	100.0	99.8
Sample size	19	1061	209	301	87	78	10,478

1. Does not include 67 wings from geese and non-game birds, 65 wings outside Flyway, or 117 wings from hunters not in original sample.

2. Includes 3 mottled ducks identified in the Louisiana sample; others may have been present in Alabama and Mississippi.

Table 17. Species Composition of the 1959 Kill (Percentage of Total Kill) in Four Parts of Minnesota

1/	Northwest	North Central	Northeast	Southern	Statewide
Mallard	33.8	32.8	19.1	35.5	31.3
G.W. Teal	7.0	2.5	2.3	18.4	10.1
B.W. Teal	9.5	8.8	2.8	14.6	10.2
L. Scaup	25.3	24.0	30.9	3.0	16.8
Ring neck	5.3	18.5	19.6	2.3	8.8
Others	19.1	13.5	25.3	26.2	22.7
Total	100.0	100.1	100.0	100.0	99.9
Sample size	831	525	750	1539	3645
% of Total sample	22.8	14.4	20.6	42.2	100.0

1/ See Figure 4

Table 18. Species Composition of the Minnesota Kill by Periods.

	Oct. 7-10	Oct. 11-20	Oct. 21-31	Nov. 1-10	Nov. 11-20	Nov. 21-30
Mallard	35.6%	24.8	24.2	54.2	66.7	10.0
Mallard x Black	0.1		0.2			
Black	3.7	1.9	2.0	2.4	4.2	20.0
Gadwall	3.3	4.0	2.2	2.4	4.2	
Am. Widgeon	5.4	5.4	3.0	3.0		
G.W. Teal	12.3	8.5	8.3	7.2		
B.W. Teal	18.2	3.8	1.8	0.6		
Shoveler	0.9	0.6	0.4	0.6		
Pintail	3.6	2.4	2.0	1.8	12.5	
Wood Duck	3.8	1.0	0.5	1.2		
Redhead	1.0	2.0	1.8	0.6		
Canvasback	0.3	0.5	0.4			
G. Scaup	0.3	1.7	1.8	0.6		
L. Scaup	2.5	27.5	38.4	22.3	8.3	20.0
Ringneck	8.0	10.7	10.8	1.8		
Goldeneye	0.2	1.6	0.9		4.2	40.0
Bufflehead	0.3	2.4	1.3	0.6		10.0
Old Squaw		Trace				
W.W. Scoter		Trace				
Ruddy	0.3					
R.B. Merganser		0.2		0.6		
H. Merganser	0.3	0.5				
Total	99.8	99.9	100.0	99.9	100.1	100.00
Sample Size	1734	1145	554	166	24	10

Table 19. Species Composition of the Wisconsin Kill by Periods.

	Oct. 7-10	Oct. 11-20	Oct. 21-31	Nov. 1-30
Mallard	29.1%	29.5	24.6	32.4
Mallard x Black	1.8	0.6		0.7
Black	5.6	6.4	9.5	5.5
Gadwall	0.2	0.2		
Am. Widgeon	6.0	5.1	5.0	2.0
G.W. Teal	12.4	9.4	3.9	3.4
B.W. Teal	25.1	6.2	2.2	1.4
Shoveler	0.4	0.4		
Pintail	2.9	3.6	3.9	0.7
Wood Duck	8.4	7.1	3.4	0.7
Redhead	0.2	1.5	1.1	
Canvasback	0.4	1.7		1.4
G. Scaup	0.2	2.4		1.4
L. Scaup	2.0	15.8	27.4	20.0
Ringneck	3.6	4.9	14.0	13.1
Goldeneye		0.6	0.6	5.5
Bufflehead	0.4	2.8	3.4	5.5
W.W. Scoter				
C. Eider		0.2		
Ruddy	0.7	0.9		2.0
C. Merganser				0.7
R.B. Merganser		0.2		0.7
H. Merganser	0.4	0.4	1.1	2.8
Total	99.8	99.9	100.1	99.9
Sample Size	450	468	179	145

Table 20. Species Composition of the Michigan Kill by Periods.

	Oct. 7-10	Oct. 11-20	Oct. 21-31	Nov. 1-10	Nov. 11-20
Mallard	23.1%	22.3	18.8	8.7	9.5
Mallard x Black	0.4			0.7	
Black	14.6	13.7	14.7	7.2	17.9
Gadwall		1.0		0.7	
Am. Widgeon	8.8	10.2	2.4	2.9	3.6
G.W. Teal	17.3	6.1	2.9	1.4	3.6
B.W. Teal	14.6	3.0	1.2		1.2
Shoveler	0.8	0.5		1.4	
Pintail	10.0	6.6	0.6	1.4	
Wood Duck	3.5	7.1		1.4	
Redhead	1.2	5.1	7.0	8.0	7.1
Canvasback	0.8	1.5	3.5	4.3	2.4
G. Scaup	1.5	5.6	10.6	16.0	7.1
L. Scaup	1.2	9.1	18.2	25.4	16.7
Ringneck	0.4	3.0	2.4	2.2	2.4
Goldeneye	1.9	1.5	2.4	5.1	10.7
Bufflehead		1.0	10.6	10.9	11.9
Old Squaw					1.2
C. Eider		0.5			
W.W. Scoter					1.2
Ruddy				0.7	
R.B. Merganser		0.5	0.6	0.7	2.4
H. Merganser		1.5	4.1	0.7	1.2
Total	100.1	98.8	100.0	99.8	100.1
Sample Size	260	197	170	138	84

Table 21. Species Composition of the Ohio Kill by Periods.

	Oct. 11-20	Oct. 21-31	Nov. 1-10	Nov. 11-30
Mallard	27.9%	21.3	29.5	23.1
Mallard x Black			0.9	1.5
Black	6.8	11.3	9.8	21.5
Gadwall				
Am. Widgeon	3.2	5.6	4.5	10.8
G.W. Teal	8.4	19.4	11.6	3.1
B.W. Teal	4.7	1.9		
Shoveler	0.5		0.9	
Pintail	2.7	5.0	8.0	3.1
Wood Duck	37.4	25.6	3.6	9.2
Redhead		0.6	4.5	3.1
Canvasback			2.7	
G. Scaup			0.9	
L. Scaup	3.2	3.1	2.7	13.8
Ringneck	4.2		5.4	1.5
Goldeneye			0.9	6.2
Bufflehead			8.0	1.5
Am. Scoter	1.1	1.3		
Ruddy		2.5	0.9	
C. Merganser				1.5
R.B.Merganser		2.5	0.9	
H. Merganser			4.5	
Total	100.1	100.1	100.2	99.9
Sample Size	190	160	112	65

Table 22. Species Composition of the Iowa Kill by Periods.

	Oct. 11-20	Oct. 21-31	Nov. 1 thru Dec. 10
Mallard	33.3%	42.8	60.4
Black		0.6	1.5
Gadwall	7.9	2.9	1.5
Am. Widgeon	15.9	5.8	2.2
G.W. Teal	20.6	15.6	11.2
B.W. Teal	4.8	2.3	
Shoveler	3.2	2.9	
Pintail	6.3	5.9	2.2
Wood Duck	1.6	4.6	1.5
Redhead	1.6	0.6	1.5
Canvasback			
G. Scaup		1.2	0.7
L. Scaup	1.6	9.3	11.2
Ringneck	3.2	3.5	1.5
Goldeneye		1.2	1.5
Bufflehead		0.6	0.7
Old Squaw			
W.W. Scoter		0.6	
Ruddy			
H. Merganser			2.2
Total	100.0	100.4	99.8
Sample Size	63	173	134

Table 23. Species Composition of the Illinois Kill by Periods.

	Oct. 21-31	Nov. 1-10	Nov. 11-21	Nov. 21 thru Dec. 10
Mallard	51.3%	68.6	63.0	81.5
Mallard x Black		0.2	1.1	
Black	0.5	2.1	6.2	6.0
Gadwall	3.7	1.9	1.5	0.5
Am. Widgeon	4.7	3.7	4.8	0.5
G.W. Teal	13.1	4.0	4.4	0.5
B.W. Teal	4.7	0.4		
Shoveler	3.7	1.2	1.1	
Pintail	3.1	2.5	0.7	1.1
Wood Duck	10.5	3.5	1.1	1.1
Redhead	1.0	0.2	0.4	
Canvasback		0.4	0.7	1.6
G. Scaup		1.0	0.7	0.5
L. Scaup	0.5	6.2	7.7	3.8
Ringneck	2.6	1.9	4.4	
Goldeneye		0.2	1.1	2.7
Bufflehead		1.0		
Am. Scoter	0.5			
Ruddy		0.2		
R.B Merganser			0.4	
H. Merganser		0.8	0.7	
Total	99.9	99.8	100.0	99.8
Sample Size	191	516	273	184

Table 24. Species Composition of the Missouri Kill by Periods.

	Nov. 1-10	Nov. 11-20	Nov. 21-30	Dec. 1-31
Mallard	63.8%	62.3	89.3	98.4
Mallard x Black	0.3	1.0		
Black	0.3	1.0		1.6
Gadwall	2.1	4.0	0.8	
Am. Widgeon	5.9	6.0		
G.W. Teal	10.7	12.0		
B.W. Teal	0.3			
Shoveler	1.4			
Pintail	2.1	4.0	4.1	
Wood Duck	3.1	2.0	1.7	
Redhead	0.3			
Canvasback			0.8	
L. Scaup	4.8	3.5	3.3	
Ringneck	3.1	1.0		
Goldeneye	0.3			
Bufflehead	0.3	1.0		
Ruddy		0.5		
C. Merganser	0.3			
R.B. Merganser		0.5		
H. Merganser	0.7	1.0		
Total	99.8	99.8	100.0	100.0
Sample Size	290	199	121	125

Table 25. Species Composition of the Arkansas Kill by Periods.

	Nov. 21-30	Dec. 1-10	Dec. 11-20	Dec. 21-31	Jan. 1-8
Mallard	82.8%	90.7	93.7	92.2	98.3
Mallard x Black		0.3			
Black		2.3	0.7	0.5	0.8
Gadwall		1.2	1.7	1.0	
Am. Widgeon		2.0	0.3	0.5	
G.W. Teal	6.7	1.7	1.7	1.6	0.8
B.W. Teal					
Shoveler	1.9		0.7	0.5	
Pintail			0.7	1.6	
Wood Duck	4.8	1.2			
L. Scaup				0.5	
Ringneck	3.8	0.3		1.0	
Goldeneye			0.3	0.5	
H. Merganser		0.3			
Total	100.0	100.0	99.8	99.9	99.9
Sample Size	105	344	285	93	117

Table 26. Species Composition of the Louisiana Kill by Periods.

	Nov. 21-30	Dec. 1-10	Dec. 11-20	Dec. 21-31	Jan. 1-8
Mallard	49.3%	60.0	55.6	47.7	36.4
Mallard x Black	1.4				
Black	4.3	2.5			
Mottled	1.4	2.5		1.5	
Gadwall	2.9		1.4	1.5	
Am. Widgeon	2.9			3.1	
G.W. Teal	2.9	5.0	5.6	4.6	
B.W. Teal		7.5	8.3	12.3	25.0
Shoveler	7.2	2.5		1.5	
Pintail	10.1	7.5	9.7	13.8	38.6
Wood Duck	10.1	7.5	5.6		
Canvasback			1.4	1.5	
L. Scaup	4.3		6.9	6.2	
Ringneck	1.4	5.0	5.6	6.2	
Goldeneye	1.4				
Total	99.6	100.0	100.1	99.9	100.0
Sample Size	69	40	72	65	44

Table 27. Relationship between Species Composition and Hunter Success. 1958 Minnesota Pilot Study

Total Reported Kill	Percentage of Mallards	Percentage of Other Dabblers	Percentage of Divers	Total	Sample Size
1-10	51.7	36.8	11.5	100.0	288
11-20	49.8	34.6	15.5	99.9	309
21-100	48.7	28.3	23.0	100.0	499

Table 28. Relationship between Species Composition and Hunter Success. 1959-60 Mississippi Flyway Wing Survey.

State	Total Reported Kill	Percentage of Mallards	Percentage of Other Dabblers	Percentage of Divers	Total Percentages	Sample Size
MINNESOTA	1 - 10	31.4	41.3	27.4	100.1	1470
	11 - 20	36.2	39.0	34.8	100.0	1007
	21 - +	36.2	31.7	32.1	100.0	1191
WISCONSIN	1 - 10	31.5	50.6	17.9	100.0	678
	11 - 20	29.1	44.8	26.1	100.0	177
	21 - +	25.4	31.7	43.0	100.1	415
MICHIGAN	1 - 10	19.3	40.9	39.8	100.0	399
	11 - 20	23.6	48.8	27.5	100.0	184
	21 - +	14.6	42.9	42.5	100.0	287
IOWA	1 - 10	43.9	43.2	12.9	100.0	134
	11 - 20	48.2	31.9	19.9	100.0	142
	21 - +	52.6	35.8	11.6	100.0	96
ILLINOIS	1 - 10	64.1	25.0	10.9	100.0	452
	11 - 20	66.2	24.2	9.6	100.0	263
	21 - +	70.2	19.6	10.3	100.1	503
OHIO	1 - 10	25.7	57.8	16.5	100.0	311
	11 - 20	27.6	65.9	6.5	100.0	130
	21 - +	26.3	57.9	15.8	100.0	100
LOUISIANA	1 - 10	59.6	31.9	8.5	100.0	47
	11 - 20	40.7	50.0	9.3	100.0	86
	21 - +	50.6	40.4	9.0	100.0	168

Table 29. Comparison of Species Composition of the Kill in the Mississippi Flyway as Shown by the Mail Questionnaire Survey and by the Wing Collection[1]

Species	Percentage of Total Kill Based On:			
	Mail Questionnaire Survey Weighted by Respondents and		Mail Wing Collection Weighted by Hunter Contacts and	
	58-59 duck stamp sales	59-60 duck stamp sales	58-59 duck stamp sales	Wings received vs. 59-60 mail kill survey estimates[2]
Mallard	42.44	42.38	39.45	38.15
Black	4.76	4.43	4.94	5.12
Gadwall	0.71	0.73	1.96	1.91
Am. Widgeon	2.36	2.40	4.94	4.97
G.W. Teal	10.10	10.31	9.15	9.32
B.W. Teal	9.91	10.21	6.39	6.52
Shoveler	0.78	0.80	0.79	0.75
Pintail	3.56	3.56	3.26	3.31
Wood Duck	4.09	3.99	4.02	4.67
Redhead	1.41	1.38	1.52	1.54
Canvasback	1.60	1.59	0.75	0.74
Scaup	12.58	12.69	13.02	13.00
Ring neck	1.57	1.56	5.06	5.16
Goldeneye	1.13	1.13	1.16	1.15
Bufflehead	1.11	1.09	1.72	1.74
Ruddy	0.45	0.44	0.24	0.27
Mergansers	1.27	1.15	0.92	0.96
Scoters	0.13	0.12	0.26	0.24
Other	0.04	0.03	0.45	0.47
Total	100.0	99.9	100.0	100.0

[1]Comparison confined to States having adequate wing collections: Illinois, Iowa, Michigan, Minnesota, Missouri, Ohio and Wisconsin.

[2]Using 1958-59 duck stamp sales

Table 30. Comparison of Species Composition of the Kill in Seven States as Shown by the Mail Questionnaire Survey and the Wing Collection[1]

SPECIES	MINNESOTA		WISCONSIN		MICHIGAN		IOWA		ILLINOIS		OHIO		MISSOURI	
	Mail Quest.	Wing Col.	Mail Quest.	Wing Col.	Mail Quest.	Wing Col.	Mail Quest.	Wing Col.	Mail Quest.	Wing Col.	Mail Quest.	Wing Col.	Mail Quest.	Wing Col.
Mallard	36.0	31.3	36.5	28.9	23.8	18.3	55.5	49.4	62.4	66.5	32.5	25.6	76.7	73.5
Black	.9	2.9	4.5	6.4	13.5	13.6	1.0	.8	4.6	3.4	16.4	10.4	1.1	.7
Gadwall	.8	3.3	.8	.2	.2	.3	1.7	3.1	.4	2.0	.6	0.0	.6	2.0
A. Widgeon	1.9	4.9	3.6	5.1	3.1	6.2	2.9	6.1	1.8	3.5	2.7	5.0	.8	4.1
G.W. Teal	13.8	10.1	11.6	9.0	7.1	8.4	11.5	14.3	5.0	5.3	8.2	11.6	5.1	7.4
B.W. Teal	15.2	10.2	12.7	12.0	8.1	5.4	7.2	1.8	3.8	.9	3.8	2.2	2.7	.1
Shoveler	.9	.7	1.1	.3	.4	.6	.8	1.8	.6	1.3	.7	.4	.5	.6
Pintail	3.9	3.0	3.4	3.0	3.1	4.8	4.7	4.6	2.4	2.0	5.4	4.5	2.3	2.6
Woodduck	2.4	2.3	5.9	6.3	2.5	3.0	3.1	2.8	5.2	3.7	13.7	23.5	1.7	2.0
Redhead	1.4	1.4	1.0	.9	4.0	4.8	.8	1.0	.4	.3	1.2	1.5	.1	.1
Canvasback	1.6	.4	1.4	1.0	3.5	2.2	1.0	.0	1.3	.7	.8	.6	.4	.1
G.&L. Scaup	17.5	17.8	11.2	14.1	20.6	18.6	7.8	9.2	6.3	5.8	2.8	4.5	3.4	3.4
Ringneck	1.8	8.8	1.4	6.6	.3	1.8	.8	2.6	2.3	2.2	1.2	3.0	3.0	1.5
Goldeneye	.8	.9	1.8	1.0	2.3	3.2	.2	1.0	1.0	.7	1.0	.9	.3	.1
Bufflehead	.6	1.2	1.2	2.3	3.6	5.3	.3	.5	.9	.4	1.1	1.9	.2	.4
Ruddy	.2	.1	.6	.8	1.1	.2	.2	.0	.4	.1	.8	.9	.3	.1
Mergansers	.3	.4	1.1	1.0	2.2	2.1	.4	.8	1.1	.7	6.5	2.0	.8	.8
Scoters	.0	.1	.2	.0	.4	.8	trace	.3	.0	.1	.5	.8	.1	.0
Others	trace	.3	trace	1.1	.1	.3	.0	.0	.0	.4	.2	.7	.0	.4
Total	100.1	100.1	100.0	100.0	99.9	99.9	100.0	100.1	99.9	99.9	100.1	100.0	100.1	99.9
Sample Size	7551	3661	12,553	1252	8143	870	7117	391	4982	1216	3922	536	5968	739

[1]This table includes data from all States in the Mississippi Flyway having an adequate wing collection sample, as indicated by a reasonable geographic distribution and sample size.

Table 31. Comparison of Species Composition of Banded Birds Reported to the Banding Office by Hunters and by Banders

Species	Number of Birds		Percentage	
	By Bander	By Hunter	By Bander	By Hunter
Mallard	15,503	10,664	54.78	58.61
Black	2,852	1,787	10.09	9.82
Gadwall	313	122	1.11	0.67
American Widgeon	729	416	2.58	2.29
Green-winged Teal	619	350	2.19	1.92
Blue-winged Teal	683	387	2.41	2.12
Shoveler	130	63	0.46	0.35
Pintail	4,873	2,842	17.22	15.62
Wood Duck	487	272	1.72	1.49
Redhead	1,003	594	3.54	3.26
Canvasback	396	345	1.40	1.90
G. & L. Scaup	502	273	1.77	1.50
Ring-necked Duck	164	42	0.57	0.23
Goldeneyes	18	12	0.06	0.07
Bufflehead	16	10	0.06	0.05
Ruddy Duck	5	5	0.02	0.03
Mergansers	6	12	0.02	0.07
Total	28,299	18,196	100.00	100.00

Table 32. Age Ratios in the Wing Collection

	Number of wings coming from:														Flyway Age Ratio	
	Minn.	Wisc.	Mich.	Iowa	Ill.	Ind.	Ohio	Mo.	Ky.	Ark.	Tenn.	La.	Miss.	Ala.	Flyway Total	Immatures per Adult Unweighted	Immatures per Adult Weighted
Mallard																	
Imm.	602	234	110	63	320	19	79	182	2	302	60	53	16	6	2048	.81	.77
Ad.	500	110	43	119	497	13	51	357	9	599	122	87	26	11	2544		
Black																	
Imm.	76	58	74	3	28	3	35	5	3	8	17	4	2	1	317	2.30	1.53
Ad.	23	19	35	0	16	3	17	0	2	3	17	0	0	3	138		
Gadwall																	
Imm.	69	0	1	7	17	0	0	9	0	5	7	0	0	1	116	1.43	1.39
Ad.	47	2	2	4	5	0	0	6	0	6	1	3	2	3	81		
A. Widgeon																	
Imm.	106	35	30	17	30	2	10	26	0	6	5	3	2	2	274	1.56	1.60
Ad.	71	25	24	6	13	2	17	4	0	3	7	1	2	1	176		
G. W. Teal																	
Imm.	210	66	41	29	32	0	35	25	0	7	4	4	4	1	458	1.99	1.95
Ad.	94	29	19	22	17	1	20	20	0	4	2	1	0	1	230		
B. W. Teal																	
Imm.	211	95	38	7	6	0	5	0	0	0	0	2	0	0	364	1.63	1.59
Ad.	134	47	8	0	4	0	7	1	0	0	1	21	0	0	223		
Shoveller																	
Imm.	20	1	2	1	11	1	2	4	0	5	1	4	0	1	53	2.40	2.34
Ad.	5	3	3	1	5	1	0	0	0	0	1	3	0	0	22		
Pintail																	
Imm.	67	21	24	9	17	0	19	11	0	3	2	14	2	0	189	1.33	1.12
Ad.	40	14	19	9	7	0	5	8	0	2	3	35	0	0	142		
Wood duck																	
Imm.	44	48	13	7	17	4	75	6	0	5	3	9	10	4	245	1.48	1.45
Ad.	28	24	12	2	25	1	43	9	0	5	2	3	8	4	166		

Table 32(Cont'd). Age Ratios in the Wing Collection

	Number of wings coming from:															Flyway wide Age Ratio	
	Minn.	Wisc.	Mich.	Iowa	Ill.	Ind.	Ohio	Mo.	Ky.	Ark.	Tenn.	La.	Miss.	Ala.	Flyway Total	Immatures per Adult	
																Unweighted	Weighted
Redhead																	
Imm.	18	4	12	2	1	0	2	0	0	0	0	0	1	0	40	.48	.47
Ad.	34	7	30	2	3	0	6	1	0	0	0	0	0	1	84		
Canvasback																	
Imm.	8	6	13	0	2	0	2	0	1	0	0	1	1	0	34	1.03	1.00
Ad.	6	8	6	0	7	0	1	1	1	0	1	1	0	1	33		
G. Scaup																	
Imm.	27	11	37	2	5	0	1	0	0	0	0	0	0	2	85	2.36	2.20
Ad.	7	3	22	0	3	0	0	0	0	0	0	0	0	1	36		
L. Scaup																	
Imm.	352	79	47	16	32	0	12	16	0	0	1	3	1	2	561	1.25	1.17
Ad.	237	80	47	15	30	1	11	9	0	0	3	10	0	6	449		
Ringneck																	
Imm.	194	59	9	6	13	0	5	7	0	2	0	3	2	10	310	1.57	1.47
Ad.	108	27	6	3	10	0	10	3	0	5	1	7	5	12	197		
Goldeneye																	
Imm.	21	6	19	3	7	0	3	1	0	1	0	0	0	0	61	2.10	2.13
Ad.	11	4	7	1	3	0	1	0	0	1	0	1	0	0	29		
Bufflehead																	
Imm.	27	12	32	2	5	0	6	1	0	0	0	0	1	1	87	1.89	2.02
Ad.	13	16	13	0	1	0	3	0	0	0	0	0	0	0	46		
H. Merganser																	
Imm.	9	7	9	3	5	0	1	0	0	1	0	0	1	0	36	2.00	2.49
Ad.	3	3	3	0	1	0	4	4	0	0	0	0	0	0	18		

Table 33. Mallard Age Ratios in the Wing Collection

	Immatures	Adult	Immatures/Adult
Minnesota	602	500	1.20
Wisconsin	234	110	2.13
Michigan	110	43	2.56
Iowa	63	119	0.53
Illinois	320	497	0.64
Indiana	19	13	1.46
Ohio	79	51	1.55
Missouri	182	357	0.51
Kentucky	2	9	0.22
Arkansas	302	599	0.50
Tennessee	60	122	0.49
Louisiana	53	87	0.61
Mississippi	16	26	0.62
Alabama	6	11	0.55

Table 34. Seasonal Changes in Mallard Age Ratios as a Whole

Period	Numbers of		Age Ratio Immatures per Adult	
	Immatures	Adults	Observed	Weighted
Oct. 7-13	610	391	1.56	1.65
14-20	157	128	1.23	1.16
21-27	121	117	1.03	0.77
Oct. 28-Nov. 3	136	211	0.64	0.60
Nov. 4-10	273	326	0.84	0.85
11-17	123	196	0.63	0.61
18-24	58	73	0.79	0.78
Nov. 25-Dec. 1	149	240	0.62	0.62
Dec. 2-8	147	212	0.69	0.69
9-15	63	152	0.41	0.41
16-22	73	190	0.38	0.38
23-29	54	101	0.53	0.53
Dec. 30-Jan. 8	53	155	0.34	0.34
TOTAL	2,017	2,492	0.81	0.77

Table 35. Seasonal Changes in Mallard Age Ratios in Certain States of the Mississippi Flyway

State	Period	Age Ratio Imm/Adult	Sample Size
Minnesota			
	Oct. 7	1.91	204
	" 8-13	1.11	545
	" 14-20	0.83	117
	Oct. 21-Nov. 3	1.17	152
	Nov. 4-25	1.33	77
	Total	1.21	1,095
Wisconsin	Oct. 7	5.00	30
	" 8-13	2.52	155
	" 14-27	1.42	104
	Oct. 28-Nov. 25	1.89	52
	Total	2.10	341
Michigan	Oct. 7-11	4.54	61
	" 12-25	2.38	54
	Oct. 26-Nov. 15	1.06	33
	Total	2.44	148
Iowa	Oct. 20-26	0.28	69
	Oct. 27-Nov. 2	0.45	45
	Nov. 3-Dec. 8	1.00	66
	Total	0.52	180
Illinois	Oct. 30	0.79	52
	Oct. 31-Nov. 3	0.42	158
	Nov. 4-10	0.85	239
	Nov. 11-17	0.53	153
	Nov. 18-Dec. 8	0.80	179
	Total	0.67	781
Ohio	Oct. 16-20	2.13	47
	Oct. 21-Nov. 24	1.25	81
	Total	1.51	128

Table 35 (Cont'd) Seasonal Changes in Mallard Age Ratios in Certain States of the Mississippi Flyway

State	Period	Age Ratio Imm/Adult	Sample Size
Missouri	Nov. 6	0.64	77
	Nov. 7-12	0.67	155
	Nov. 13-26	0.41	140
	Nov. 27-Dec. 25	0.42	160
	Total	0.51	532
Arkansas	Nov. 30	0.74	87
	Dec. 1-4	0.64	185
	" 5-11	0.80	115
	" 12-18	0.41	161
	" 19-25	0.35	142
	Dec. 26-Jan. 1	0.29	115
	Jan. 2 - 8	0.42	84
	Total	0.50	889
Tennessee	Nov. 30-Dec. 6	0.57	58
	Dec. 7-20	0.40	49
	Dec. 21-Jan. 8	0.50	75
	Total	0.49	182
Louisiana	Nov. 26-Dec. 14	0.70	63
	Dec. 15-Jan. 4	0.54	71
	Total	0.61	134

Table 36. Mallard Age Ratios from Bag-Checks in the Mississippi Flyway: Summary of Data Presented by Arthur S. Hawkins in Memos to the Mississippi Flyway Council

Location	Period	Age Ratio	Sample Size	Source
Minnesota				
Twin City Locker Plant	Week prior to Oct. 16	0.96	211	Memo 6
"	October 19	0.59	about 150	Memo 7
"	October 26	0.93	70	Memo 8
"	Month prior to Nov. 15	0.65	507	Memo 9
Roseau River Refuge	Prior to Oct. 16	2.24	402	Memo 6
Ohio				
Lake Erie Marshes		1.50		Memo 9
Illinois				
Mouth Ill. River	Oct. 31-Dec. 7	0.43	857	Memo 11
Missouri				
Duck Creek Area		0.6	1283	Memo 11
Arkansas				
Stuttgart	Nov. 30-Dec. 1	0.3	1053	Memo 11

Table 37. Summary of Mallard Age Ratios in Supplemental Wing Collections.

Flyway	Location	Date	Number of Wings: Immature Male	Immature Female	Adult Male	Adult Female	Unknown or Incomplete	Total Wings	Age ratio Im/Ad
Atlantic	South Carolina								
	Georgetown	59-60 Season	16	22	22	9	2	71	1.22
Mississippi	Manitoba	Oct. 20							
	Brandon	Sept. 18-27	50	61	72	53	6	242	0.89
	Portage	Sept. 18-19	15	12	17	8	1	53	1.08
		21-26	28	24	41	16	0	109	0.91
		28-Oct.3	18	20	45	15	1	99	0.63
		Oct. 4 -10	10	24	16	26	1	77	0.81
		11-17	40	67	59	71	7	244	0.82
		18-24	36	63	66	54	6	225	0.82
		Season	146	210	244	190	16	807	0.82
	Winnipeg	Sept.21-Oct.6	28	39	15	13	0	95	2.39
		Oct. 21-26	29	16	24	18	2	89	1.07
		27-31	31	25	21	39	6	122	0.93
			88	80	60	70	8	306	1.29
	Winnipegosis	Sept.19-Oct.24	12	10	13	16	1	52	0.76
	Illinois Central and Crane Lake Clubs								
		Oct.30-Nov.3	10	9	22	5	3	49	0.70
		Nov. 5 & 8	7	16	13	14	0	50	0.85
		11 & 13	19	13	51	27	4	114	0.41
		18 & 30	14	13	74	24	2	127	0.27
		Total	50	51	160	70	9	340	0.44

Table 37. Summary of Mallard Age Ratios in Supplemental Wing Collections (Cont'd).

Flyway	Location	Date	Number of Wings: Immature Male	Immature Female	Adult Male	Adult Female	Unknown or Incomplete	Total Wings	Age ratio Im/Ad
Mississippi	Missouri								
	Charles Co.	-	6	14	7	14	33		1.54
	Arkansas								
	Manila	-	7	16	26	16	0	65	0.55
	Lynn	-	6	4	9	3	0	22	0.83
		Dec. 21	7	4	24	6	2	43	0.37
		26	24	8	37	19	12	100	0.57
		Jan. 1	21	13	39	17	5	95	0.61
		8	23	11	42	17	2	95	0.58
			81	40	151	62	21	355	0.57
	Clay Co.	-	11	7	31	12	-	61	0.42
		Dec. 9	11	11	48	25	1	96	0.30
		21	17	11	37	18	1	84	0.51
		28	11	5	31	14	-	61	0.36
		Jan. 4	17	19	47	15	2	100	0.58
		8	17	3	40	13	2	75	0.38
			84	56	234	97	6	477	0.42
	Weiner	Dec. 7	1	-	3	1	-	5	0.25
		9	8	19	40	32	-	99	0.38
		15	10	14	46	20	3	93	0.36
		21	13	5	52	25	5	100	0.23
		26	12	17	35	26	6	96	0.48
		Jan. 5	13	10	48	21	3	95	0.33
			57	65	224	125	17	488	0.35

Table 37. Summary of Mallard Age Ratios in Supplemental Wing Collections (Cont'd).

Flyway	Location	Date	Number of Wings: Immature Male	Immature Female	Adult Male	Adult Female	Unknown or Incomplete	Total Wings	Age ratio Im/Ad
Mississippi	Stuttgart	Dec. 1	15	15	41	27	2	100	0.44
		14	4	6	25	9	24	68	0.29
		21	13	15	40	26	7	101	0.42
		28	9	6	41	14	28	98	0.27
		29	11	15	46	16	7	95	0.42
		Jan. 2	8	7	49	22	11	97	0.21
		4	12	18	103	44	25	177	0.20
		9	20	13	44	23	6	106	0.49
			92	95	389	181	110	867	0.33
	Little Rock	-	6	12	24	11	39	92	0.51
	Unknown	-	7	10	28	21	2	68	0.35
	Arkansas Total		334	294	1076	513	195	2412	0.40

Table 37. Summary of Mallard Age Ratios in Supplemental Wing Collections (Cont'd).

Flyway	Location	Date	Number of Wings: Immature Male	Immature Female	Adult Male	Adult Female	Unknown or Incomplete	Total Wings	Age ratio Im/Ad
Central	North Dakota								
	Lower Souris	Oct. 7-25	4	5	6	5	1	21	0.82
	Colorado	Oct.30-Dec.11	12	13	16	6	3	50	1.14
Pacific	Idaho								
	Nampa	Nov. 9	11	3	3	3	7	27	2.33
		Dec. 1	15	6	13	-	-	34	1.62
		Dec. 28	12	3	9	3	1	28	1.25
			38	12	25	6	8	89	1.61
	Utah								
	Bear River	Oct. 11-Nov. 1	21	17	66	36	0	140	0.37
	Nevada								
	Fallon	-	4	5	6	5	1	21	1.00
	California								
	Tule Lake	Oct. 13	7	10	17	18	0	52	0.48
		16	3	4	8	18	0	33	0.27
		21	4	2	12	17	0	35	0.21
		26	-	1	9	4	0	14	0.08
		Nov. 2	8	6	19	34	0	67	0.26
		22	6	3	7	12	0	28	0.47
		23	4	8	12	23	0	47	0.34
		29	-	-	-	2	0	2	0.00
		Dec. 5-7	2	6	6	4	0	18	0.80
		16,18-20	5	3	4	5	0	17	0.89
			39	43	94	137	0	313	0.35

Table 37. Summary of Mallard Age Ratios in Supplemental Wing Collection (Cont'd).

Flyway	Location	Date	Number of Wings: Immature Male	Immature Female	Adult Male	Adult Female	Unknown or Incomplete	Total Wings	Age ratio Im/Ad
Pacific	California Willows	Oct. 17	48	38	13	17	1	117	2.87
		24	48	30	9	13	9	109	3.54
		31	35	33	12	15	0	95	2.52
		Nov. 7	21	26	20	7	1	75	1.74
		14	27	28	23	22	2	102	1.22
		21	30	26	22	24	1	103	1.22
		28	24	32	23	14	1	94	1.51
		Dec. 5	23	32	20	17	4	96	1.49
		12	26	42	15	24	2	109	1.74
		18	20	5	9	-	2	36	2.78
		19	20	17	25	6	4	72	1.19
		26	46	19	38	14	2	119	1.25
		Jan. 2	13	24	32	9	1	79	.90
		8	27	24	24	20	2	97	1.16
			408	376	285	202	32	1,303	1.61
	Merced	Nov. 1, 7	50	38	9	15	8	120	3.67
		8	25	18	3	5	1	52	5.38
		11	8	14	5	3	1	31	2.75
		14 & 15	16	11	8	2	3	40	2.70
		21 & 22	11	9	1	2	0	23	6.67
		25, 26, 28 & 29	18	12	12	7	0	49	1.58
		Dec. 1 - 15	26	19	14	7	3	69	2.14
		16 - 31	41	17	18	9	7	92	2.15
		25, 26	33	9	9	3	1	55	3.50
		Dec. 26-Jan. 6	8	10	15	6	3	42	0.86
			236	157	94	59	27	573	2.57

Table 38. Regional Differences in Age Ratios of Black Duck

Area	Age Ratio Imm/adult	Sample Size
Minn., Wisc., & Mich.	2.70	285
Ill., Ia., Ind., & Ohio.	1.92	105
Rest of Flyway	1.60	65

Table 39. Seasonal Changes in Age Ratios of Black Ducks

State	Period	Age Ratio Imm/adult	Sample Size
Minnesota	Oct. 7-13	5.4	77
	Oct. 14-Nov. 25	1.0	22
Wisconsin	Oct. 7-11	3.1	33
	Oct. 12-Nov. 15	3.0	46
Michigan	Oct. 7-11	3.6	41
	Oct. 12-25	3.1	37
	Oct. 26-Nov. 15	0.8	31

Table 40. Regional Differences in Age Ratios of American Widgeon

State		Number of: Immatures	Adults	Age Ratio Imm/Adult
Minnesota		106	71	
Wisconsin		35	25	
	Total	141	96	1.47
Iowa		17	6	
Illinois		30	13	
Missouri		26	4	
Arkansas		6	3	
Louisiana		3	1	
	Total	82	27	3.04
Michigan		30	24	1.25
Ohio		10	17	
Indiana		2	2	
Tennessee		5	7	
Mississippi		2	2	
Alabama		2	1	
	Total	21	29	0.72

Table 41. Regional Differences in Age Ratios of Green-winged Teal

State	Number of: Immatures	Adults	Age Ratio Immatures per adult	
Minnesota	210	94	2.23	
Wisconsin	66	29	2.28	
Michigan	41	19	2.16	
Total	317	142		2.25
Iowa	29	22	1.31	
Illinois	32	17	1.88	
Indiana	0	1		
Ohio	35	20	1.75	
Total	96	60		1.60
Missouri	25	20	1.25	
Arkansas	7	4		
Louisiana	4	1		
Kentucky	0	0		
Tennessee	4	2		
Mississippi	4	0		
Alabama	1	1		
Total	45	28	1.61	

Table 42. Seasonal Changes in Age Ratios of Green-winged Teal

State	Period	Age Ratio	Sample Size
Minnesota	Oct. 7-13	2.27	229
	Oct. 14-Nov. 10	2.04	73
Wisconsin	Oct. 7-13	2.17	57
	Oct. 14-Nov. 10	2.45	38

Table 43. Regional Differences in Age Ratios of Blue-winged Teal

State	Number of: Immatures		Adults		Age Ratio Immatures per adult
Minnesota	211		134		1.57
Wisconsin	95		47		2.02
Michigan	38		8		4.75
Total		344		189	1.8
Iowa	7		0		
Illinois	6		4		
Ohio	5		7		
Total		18		11	1.6
Missouri	0		1		
Tennessee	0		1		
Louisiana	2		21		
Total		2		23	0.1

Table 44. Seasonal Changes in Age Ratios of Blue-winged Teal

State	Period	Number of: Immatures	Adults	Age Ratio Imm/Adult
Minnesota	Oct. 7	104	64	1.62
	Oct. 8-13	94	62	1.52
	Oct. 14-Nov. 10	13	6	2.17
Wisconsin	Oct. 7	38	15	2.53
	Oct. 8-13	43	26	1.65
	Oct. 14-Nov. 10	14	6	2.33

Table 45. Regional Differences in Age Ratios of Pintails.

State	Number of: Immatures		Adults		Age Ratio Immatures per adult	
Minnesota	67		40		1.68	
Wisconsin	21		14		1.50	
Michigan	24		19		1.26	
Total		112		73		1.53
Iowa	9		9			
Missouri	11		8			
Arkansas	3		2			
Louisiana	14		35		0.40	
Total		37		54		0.68
Illinois	17		7			
Ohio	19		5			
Tennessee	2		3			
Mississippi	2		0			
Total		40		15		2.67

Table 46. Seasonal Changes in Age Ratios of Pintails in Minnesota

Period	Number of: Immatures	Adults	Age Ratio Imm/Adult
Oct. 7 - 13	50	31	1.61
Oct. 14-Nov. 17	17	9	1.89

Table 47. Age Ratios of Pintails From Supplemental Wing Collections.

Location	Date	Number of Wings: Immature Male	Immature Female	Adult Male	Adult Female	Unknown or Incomplete	Total Wings	Age Ratio Imm/Adult
California								
Tule Lake	11/28/59	1	3	4	7	-	14	0.27
	11/29/59	1	4	10	7	1	23	0.29
	11/30/59	1	-	6	7	-	14	0.08
	12/ 1/59	4	7	8	12	1	32	0.52
	12/ 5/59	2	6	10	9	-	27	0.42
	12/15-18/59	0	1	15	4	1	21	0.05
Totals		8	21	53	46	3	131	0.29
Willows	10/17/59	16	15	39	12	-	82	0.61
	10/24/59	18	7	57	16	-	98	0.34
	10/31/59	32	18	16	29	-	95	1.11
	11/ 7/59	22	24	26	24	1	97	0.92
	11/17/59	14	13	36	36	-	99	0.38
	11/21/59	18	11	51	19	-	99	0.41
	11/28/59	33	16	25	25	-	99	0.98
	12/ 5/59	18	22	41	20	-	101	0.66
	12/12/59	10	12	35	41	-	98	0.29
	12/19/59	17	18	32	32	-	99	0.55
	12/26/59	1	8	15	13	-	37	0.32
	12/28/59	1	1	23	7	-	32	0.07
	12/29/59	3	4	17	3	-	27	0.35
	1/ 2/60	6	11	38	43	-	98	0.21
	1/ 7-8	10	9	35	44	-	98	0.24
Totals		219	189	486	364	1	1259	0.48
Utah								
Bear River		14	5	42	70	-	131	0.17
	10/11-10/17/59	4	1	11	15	-	31	0.19
	10/18-11/ 1/59	7	4	38	62	-	111	0.11
Totals		25	10	91	147	-	273	0.15

Table 48. Regional Differences in Age Ratios of Wood Ducks.

State	Number of: Immatures	Adults	Age Ratio Imm/Adult
Minnesota	44	28	1.6
Wisconsin	48	24	2.0
Michigan	13	12	
Iowa	2	2	
Ohio	75	43	1.7
Indiana	4	1	
Total	191	110	1.74
Illinois	17	25	0.68
Missouri	6	9	
Arkansas	5	5	
Tennessee	3	2	
Louisiana	9	3	
Mississippi	10	8	
Alabama	4	4	
Total	54	56	0.96

Table 49. Regional Differences in Age Ratios of Lesser Scaup

State	Number of: Immatures	Adults	Age Ratio Imm/Adult
Minnesota	352	237	1.48
Wisconsin	79	80	.99
Michigan	47	47	1.00
Iowa	16	15	1.07
Illinois	32	30	1.07
Indiana	0	1	
Ohio	12	11	1.09
Missouri	16	9	1.78
Total	554	430	1.28
Arkansas	1	0	
Tennessee	1	3	
Louisiana	3	10	
Mississippi	1	0	
Alabama	2	6	
Total	8	19	0.42

Table 50. Seasonal Changes in Age Ratios of Lesser Scaup

State	Period	Age Ratio	Sample Size
Minnesota	Oct. 7-13	0.73	85
	" 14-20	1.31	247
	" 21-27	2.09	142
	Oct. 28-Nov. 3	2.48	94
	Nov. 4-25	1.62	20
Wisconsin	Oct. 7-13	0.29	27
	" 14-20	0.81	56
	" 21-27	2.67	33
	Oct. 28-Nov. 3	1.40	24
	Nov. 4-25	1.10	19

Table 51. Regional Differences in Age Ratios of Ring-necked Ducks

State	Number of: Immatures	Adults	Age Ratio Imm/Adult
Minnesota	194	108	1.80
Wisconsin	59	27	2.19
Michigan	9	6	1.50
Total	262	141	1.86
Iowa	6	3	
Illinois	13	10	
Indiana	0	0	
Ohio	5	10	
Total	24	23	1.04
Missouri	7	3	
Arkansas	2	5	
Tennessee	0	1	
Louisiana	3	7	
Mississippi	2	5	
Alabama	10	12	
Total	24	33	0.73

Table 52. Seasonal Changes in Age Ratios of Ring-necked Ducks in Minnesota

Period	Age Ratio: Immatures per adult	Sample Size
Oct. 7 - 13	1.77	180
14 - 20	1.77	61
Oct. 21-Nov. 5	0.55	59

Table 5 3. Sex Ratios of Ducks in the Wing Collection Samples.

Species	Minn.	Wisc.	Mich.	Iowa	Ill.	Ind.	Ohio	Mo.	Ky.	Ark.	Tenn.	La.	Miss.	Ala.	Flyway Total	Sex Ratio Males/100 Females Unweighted	Weighted
Mallard																	
Imm. Male	299	129	49	33	180**	9	38	94	2	141	37	33	5	4	1053	107	110
Imm. Female	301	103	59	29	139**	10	41	87	0	156	23	20*	11	2	981		
Adult Male	238	51	22	68	305	7	31	242	7	391	83**	47	16	5	1513	147	149
Ad. Female	261	59	21	51	189**	6	20	115	2	207**	39**	40	10	6	1026**		
Gadwall																	
Imm. Male	41	0	1	3	7	0	0	6	0	0	6	0	0	1	65	127	127
Imm. Female	28	0	0	4	10	0	0	3	0	5	1	0	0	0	51		
Adult Male	24	1	1	4	5	0	0	4	0	4	1	3	2	3	52	183	241
Ad. Female	23	1	1	0	0	0	0	2	0	2	0	0	0	0	29		
A. Widgeon																	
Imm. Male	62	18	16	5	17	1	5	18	0	5	4	1	2	1	155	130	121
Imm. Female	44	17	14	12	13	1	5	8	0	1	1	2	0	1	119		
Adult Male	33	13	16	2	7	2	7	2	0	2	5	1	2	1	93	112	128
Ad. Female	38	12	8	4	6	0	10	2	0	1	2	0	0	0	83		
G.W. Teal																	
Imm. Male	104	28	24	12	15	0	21	13	0	7	3	1	1	1	230	97	95
Imm. Female	106	38	17	17	17	0	14	12	0	9	1	3	3	0	237		
Adult Male	40	11	8	9	5	1	8	17**	0	3	1	1	0	0	104	83	83
Ad. Female	54	18	11	13	12	0	12	3	0	1	1	0	0	1	126		

Cont'd.----

Cont'd.

Table 53. Sex Ratios of Ducks in the Wing Collection Samples.

Species	Minn.	Wisc.	Mich.	Iowa	Ill.	Ind.	Ohio	Mo.	Ky.	Ark.	Tenn.	La.	Miss.	Ala.	Flyway Total	Sex Ratio Males/100 Females	
																Unweighted	Weighted
Redhead																	
Imm. Male	13	1	5	2	1	0	0	0	0	0	0	0	1	0	23	115	102
Imm. Female	5	3	7	2	1	0	2	0	0	0	0	0	0	0	20		
Adult Male	15	3	18	0	2	0	4	1	0	0	0	0	0	0	43	105	104
Ad. Female	19	4	12	2	1	0	2	0	0	0	0	0	0	1	41		
Canvasback																	
Imm. Male	2	3	11	0	1	0	1	0	1	0	0	0	1	0	20	153	198
Imm. Female	6	2	2	0	1	0	1	0	0	0	0	1	0	0	13		
Adult Male	2	7	2	0	5	0	1	1	1	0	1	0	0	1	21	175	179
Ad. Female	4	1	4	0	2	0	0	0	0	0	0	1	0	0	12		
G. Scaup																	
Imm. Male	19	6	19	1	3	0	0	0	0	0	0	0	0	0	48	130	116
Imm. Female	8	5	18	1	2	0	1	0	0	0	0	0	0	2	37		
Adult Male	2	0	9	0	3	0	0	0	0	0	0	0	0	0	14	64	64
Ad. Female	5	3	13	0	0	0	0	0	0	0	0	0	0	1	22		
L. Scaup																	
Imm. Male	187	30	16	8	15	0	4	6	0	1	1	2	1	0	271	93	89
Imm. Female	165	49	31	8	17	0	8	10	0	0	0	1	0	2	291		
Adult Male	120	40	19	10	21	1	5	8	0	0	3	5	0	4	236	111	115
Ad. Female	117	40	28	5	9	0	6	1	0	0	0	5	0	2	213		

Cont'd.----

Cont'd.

Table 53. Sex Ratios of Ducks in the Wing Collection Samples.

Species	Minn.	Wisc.	Mich.	Iowa	Ill.	Ind.	Ohio	Mo.	Ky.	Ark.	Tenn.	La.	Miss.	Ala.	Flyway Total	Sex Ratio Males/100 Females Unweighted	Weighted
B.W. Teal																	
Imm. Male	104	38	14	4	1	0	2	0	0	0	0	1	0	0	164	82	80
Imm. Female	107	57	24	3	5	0	3	0	0	0	0	1	0	0	200		
Adult Male	31	12	2	0	1	0	2	0	0	0	0	7	0	0	55	33	34
Ad. Female	103	35	6	0	3	0	5	1	0	0	1	14	0	0	168		
Shoveler																	
Imm. Male	13	1	2	1	5	1	1	1	0	2	1	3	0	1	32	123	123
Imm. Female	7	0	0	5	6	0	1	3	0	3	0	1	0	0	26		
Adult Male	1	2	2	1	4	0	0	0	0	0	1	0	0	0	11	100	91
Ad. Female	4	1	1	0	1	1	0	0	0	0	0	3	0	0	11		
Pintail																	
Imm. Male	45*	12	13	4	6	0	11	8	0	0	1	10	2	0	112	145	139
Imm. Female	22*	9	11	5	11	0	8	3	0	3	1	4	0	0	77		
Adult Male	16	3	8	4	3	0	3	3	0	1	2	27*	0	0	70	97	116
Ad. Female	24	11	11	5	4	0	2	5	0	1	1	8	0	0	72		
Wood Duck																	
Imm. Male	27	33*	5	4	5	2	44	2	0	4	2	7	5	2	142	139	130
Imm. Female	17	14*	8	3	12	2	31	4	0	1	1	2	5	2	102		
Adult Male	15	12	10	1	14	0	24	3	0	4	2	2	5	2	94	131	135
Ad. Female	13	12	2	1	11	1	19	6	0	1	0	1	3	2	72		

Cont'd.----

Cont'd.
Table 53. Sex Ratios of Ducks in the Wing Collection Samples.

Species	Minn.	Wisc.	Mich.	Iowa	Ill.	Ind.	Ohio	Mo.	Ky.	Ark.	Tenn.	La.	Miss.	Ala.	Flyway Total	Sex Ratio Males/100 Females	
																Unweighted	Weighted
Goldeneye																	
Imm. Male	8	4	9	3	5	0	2	1	0	0	0	0	0	0	32	110	121
Imm. Female	13	2	10	0	2	0	1	0	0	1	0	0	0	0	29		
Adult Male	6	2	5	0	2	0	1	0	0	0	0	0	0	0	16	133	114
Ad. Female	5	2	2	1	1	0	1	0	0	1	0	1	0	0	14		
Bufflehead																	
Imm. Male	12	3	16	1	3	0	4	1	0	0	0	0	1	0	41	89	88
Imm. Female	15	9	16	1	2	0	2	0	0	0	0	0	0	1	46		
Adult Male	10	10	8	0	0	0	2	0	0	0	0	0	0	0	30	188	176
Ad. Female	3	6	5	0	1	0	1	0	0	0	0	0	0	0	16		
H. Merganser																	
Adult Male	1	3	1	0	1	0	3	2	0	0	0	0	0	0	11	157	146
Ad. Female	2	0	2	0	0	0	1	2	0	0	0	0	0	0	7		

*Significantly different from 50:50 at .05 probability level.

**Significantly different from 50:50 at .01 probability level or less.

Table 54. Regional Differences in Sex Ratios of Adult Mallards

State	Number of Adult Male	Number of Adult Female	Males/100 Females
Minnesota	238	261	91
Wisconsin	51	59	86
Michigan	22	21	105
Total	311	341	91
Iowa	68	51	
Indiana	7	6	
Ohio	31	20	
Total	106	77	138
Missouri	242	115	210
Illinois	305	189	161
Kentucky	7	2	
Arkansas	391	207	189
Tennessee	83	39	213
Total	1,028	552	186
Louisiana	47	40	
Mississippi	16	10	
Alabama	5	6	
	68	56	121

Table 55. Seasonal Changes in Sex Ratios of Adult Mallards in the Mississippi Flyway

Period		Total		Sex Ratio (males/ 100 females)	
		Observed	Weighted	Observed	Weighted
Oct. 7-13	male	180	134	85	85
	female	211	158		
14-20	male	64	57	100	102
	female	64	56		
21-27	male	49	60	72	78
	female	68	77		
Oct. 28- Nov. 3	male	123	128	140	139
	female	88	92		
Nov. 4-10	male	221	225	210	216
	female	105	104		
11-17	male	114	113	139	135
	female	82	84		
18-24	male	54	54	284	284
	female	19	19		
Nov. 25- Dec. 1	male	162	163	208	209
	female	78	78		
Dec. 2-8	male	121	122	133	134
	female	91	91		
9-15	male	101	101	198	198
	female	51	51		
16-22	male	124	124	188	188
	female	66	66		
23-29	male	64	64	173	173
	female	37	37		
Dec. 30- Jan. 8	male	107	107	223	223
	female	48	48		

Table 56. Seasonal Changes in Sex Ratios of Adult Mallards in Nine States of the Mississippi Flyway

State	Period	Adult Sex Ratio Males/100 Females	Sample Size
Minnesota			
	Oct. 7	67	70
	" 8-13	94	258
	" 14-20	83	64
	Oct. 21-Nov. 3	67	70
	Nov. 4-25	371	33
	Total	91	495
Wisconsin			
	Oct. 7-13	75	49
	" 14-27	105	43
	Oct. 28-Nov. 25	80	18
	Total	86	110
Michigan			
	Oct. 7-11	120	11
	" 12-25	78	16
	" 26-Nov. 15	129	16
	Total	105	43
Iowa			
	Oct. 20-26	93	54
	Oct. 27-Nov. 2	121	31
	Nov. 3-Dec. 8	278	34
	Total	133	119
Illinois			
	Oct. 30-Nov. 3	150	140
	Nov. 4-10	222	129
	Nov. 11-17	92	100
	Nov. 18-Dec. 8	212	100
	Total	161	469
Missouri			
	Nov. 6-12	211	140
	" 13-26	241	99
	Nov. 27-Dec. 25	182	113
	Total	209	352

Table 56. Seasonal Changes in Sex Ratios of Adult Mallards in Nine States of the Mississippi Flyway (Cont'd)

State	Period	Adult Sex Ratio Males/100 Females		Sample Size	
Arkansas					
	Nov. 30-Dec. 4	143		163	
	Dec. 5-11	113		64	
	" 12-18	280		114	
	" 19-25	221		106	
	Dec. 26-Jan. 1	256		89	
	Jan. 2-8	195		59	
	Total		190		595
Tennessee					
	Nov. 30-Dec. 6	147		37	
	Dec. 7-20	250		35	
	Dec. 21-Jan. 8	257		50	
	Total		213		122
Louisiana					
	Nov. 26-Dec. 14	147		37	
	Dec. 15-Jan. 4	92		46	
	Total		113		83

Table 57. Regional Differences in Sex Ratios of Adult American Widgeon

State	Number of Adult Male	Number of Adult Female	Males/100 Females
Minnesota	33	38	
Wisconsin	13	12	
Iowa	2	4	
Illinois	7	6	
Missouri	2	2	
Arkansas	2	1	
Louisiana	1	0	
Total	60	63	95
Michigan	16	8	
Ohio	7	10	
Indiana	2	0	
Tennessee	5	2	
Mississippi	2	0	
Alabama	1	0	
Total	33	20	165

Table 58. Regional Differenees in Sex Ratios of Adult Pintail

State	Number of Adult Male	Number of Adult Female	Males/100 Females
Minnesota	16	24	
Wisconsin	3	11	
Michigan	8	11	
Total	27	46	59
Iowa	4	5	
Missouri	3	5	
Arkansas	1	1	
Illinois	3	4	
Ohio	3	2	
Tennessee	2	1	
Total	16	18	89
Louisiana	27	8	338

Table 59. Regional Differences in Sex Ratios of Adult Wood Duck

State	Number of Adult Male	Number of Adult Female	Males/100 Females
Minnesota	15	13	
Wisconsin	12	12	
Michigan	10	2	
Iowa	1	1	
Ohio	24	19	
Indiana	0	1	
Total	62	48	129
Illinois	14	11	
Missouri	3	6	
Arkansas	4	1	
Tennessee	2	0	
Louisiana	2	1	
Mississippi	5	3	
Alabama	2	2	
Total	32	24	133

Table 60. Regional Differences in Sex Ratios of Adult Lesser Scaup

State	Number of Adult Males	Number of Adult Females	Males/100 Females
Minnesota	120	117	
Wisconsin	40	40	
Michigan	19	28	
Ohio	5	6	
Total	184	191	96
Iowa	10	5	
Illinois	21	9	
Indiana	1	0	
Missouri	8	1	
Tennessee	3	0	
Louisiana	5	5	
Mississippi	0	0	
Alabama	4	2	
Total	52	22	236

Table 61. Relative Vulnerability Estimates for the Mallard[1]

	Banding Station						
	Manitoba	Saskatchewan	Minnesota				North Dakota
	Libau	Teo & Last Lakes	Mt. Rice L. N.W.R.	Thief L. Refuge	Mud L. N.W.R.	Roseau R. Refuge	2
Number banded:							
Adults	217	1217	273	515	125	156	511
Immatures	389	289	459	390	240	372	86
No. of Recoveries:							
Adults:							
Total	14	52	10	34	10	8	21
Miss. Flyway	7	26	10	29	10	8	14
Immatures:							
Total	29	15	27	41	26	31	10
Miss. Flyway	10	5	23	37	23	21	3
Recovery Rates in Per Cent:							
Adults:							
Total	6.4	4.3	3.7	6.6	8.0	5.1	4.1
Miss. Flyway	3.2	2.1	3.7	5.6	8.0	5.1	2.7
Immatures:							
Total	7.4	5.2	5.9	10.5	10.8	8.3	11.6
Miss. Flyway	4.9	1.7	5.0	9.4	9.6	5.6	3.5
Relative Vulnerability[3]							
Total	1.15	1.21	1.61	1.58	1.35	1.62	(2.83)
Miss. Flyway	1.52	.81	1.37	1.69	1.20	1.10	1.27

1/ Mallards were banded at the Canadian stations from August 1-September 9, 1959 and at the United States stations during August and September, 1959. Recoveries indicate shot birds taken during the 1959-60 season.

2/ The North Dakota records include data from Arrowwood, Lower Souris and Des Lacs National Wildlife Refuges.

3/ Immature recovery rate divided by the adult recovery rate. The figures show how many times immatures were more likely to be shot than adults. Due to complications resulting from the reconstruction of fire-damaged banding records, the data in this table may be incomplete.

DUCK HUNTERS

We need wings from the ducks you kill this season.

From the wing we can tell the kind (species) of duck and whether it was hatched this past summer or was an adult bird. The ratio of young to adult birds tells us how good a "crop" of birds was produced. This will help us to manage our waterfowl so that we can harvest the crop without reducing our "seed-stock".

PLEASE COMPLETE

Where Shot:

State_____

County_____

Town_____

When Shot:

Date_____

Time (hour)_____

If banded list number_____

Name of Hunter_____

DIRECTIONS

1. Cut wing close to body.
2. Place wing in envelope before removing wing from next bird. Use one envelope for each bird - send only one wing from each bird.
3. Fill in blanks below.
4. Mail as soon as possible (no postage required).
5. Send us a post card if more envelopes are needed.
6. Please continue to send wings throughout the entire hunting season.

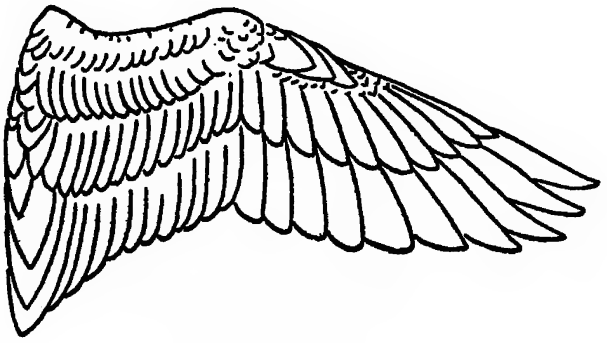


Figure 1. Information on duck-wing collection envelope.

ADDRESS ONLY THE DIRECTOR,
BUREAU OF SPORT FISHERIES
AND WILDLIFE

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
WASHINGTON 25, D. C.

Dear Waterfowl Hunter:

Your response to the waterfowl mail questionnaire sent you last year is appreciated. The information you provided was of material assistance in measuring the size of the hunting kill and providing other important information. Since you have evidenced an interest in waterfowl management we would like your assistance and cooperation in a further study to be undertaken during the 1959-60 waterfowl hunting season. This year we would like to have one wing from each duck that you shoot throughout the entire season. From these wings, we can determine the percentage of young birds among those bagged and thus obtain a measure of hatching success. This information is being collected as a cooperative study by the Bureau of Sport Fisheries and Wildlife and the Mississippi Flyway Council, of which your State is a member. Your help will provide information required for better management of our waterfowl resources.

Please follow these instructions:

1. Cut off wing (see back of enclosed envelope).

2. To avoid confusion, please place the wing in envelope before removing wing from next bird. Use one envelope for each bird. We need only one wing from each bird.

3. Fill in blanks on envelope. If the bird was banded, please send the band. We will return it if you wish.

4. Mail as soon as possible (no postage required). Prompt mailing will reduce spoilage.

5. Please continue to send wings as birds are taken. We must receive wings taken at all times during the hunting season in order to understand differences in migration among species and between young and old birds. Do not wait until end of season to send in wings.

6. If more envelopes are needed, send us a post card.

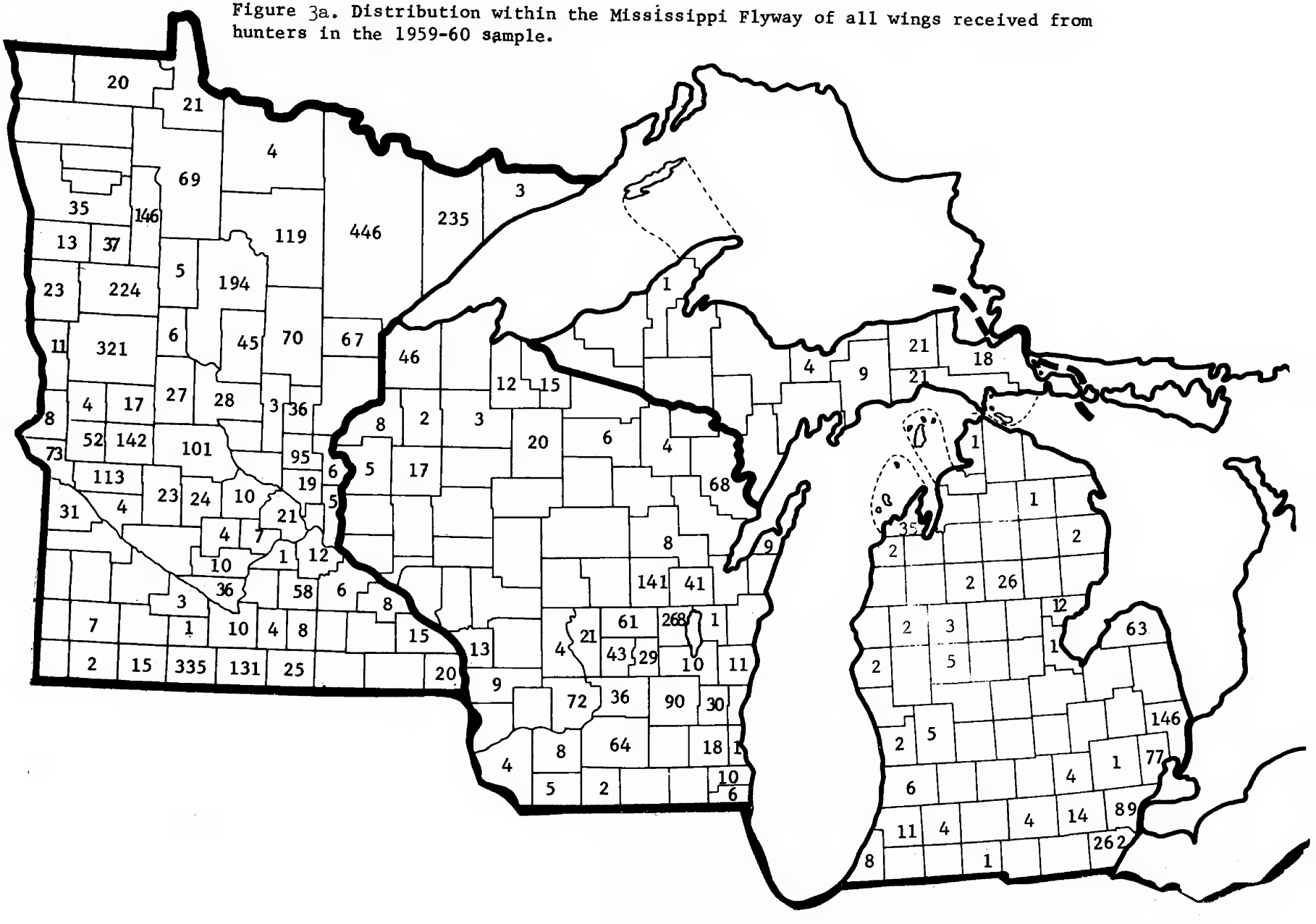
Good Hunting!

Sincerely yours,

D. H. Janzen
Director

Figure 2. Request letter.

Figure 3a. Distribution within the Mississippi Flyway of all wings received from hunters in the 1959-60 sample.



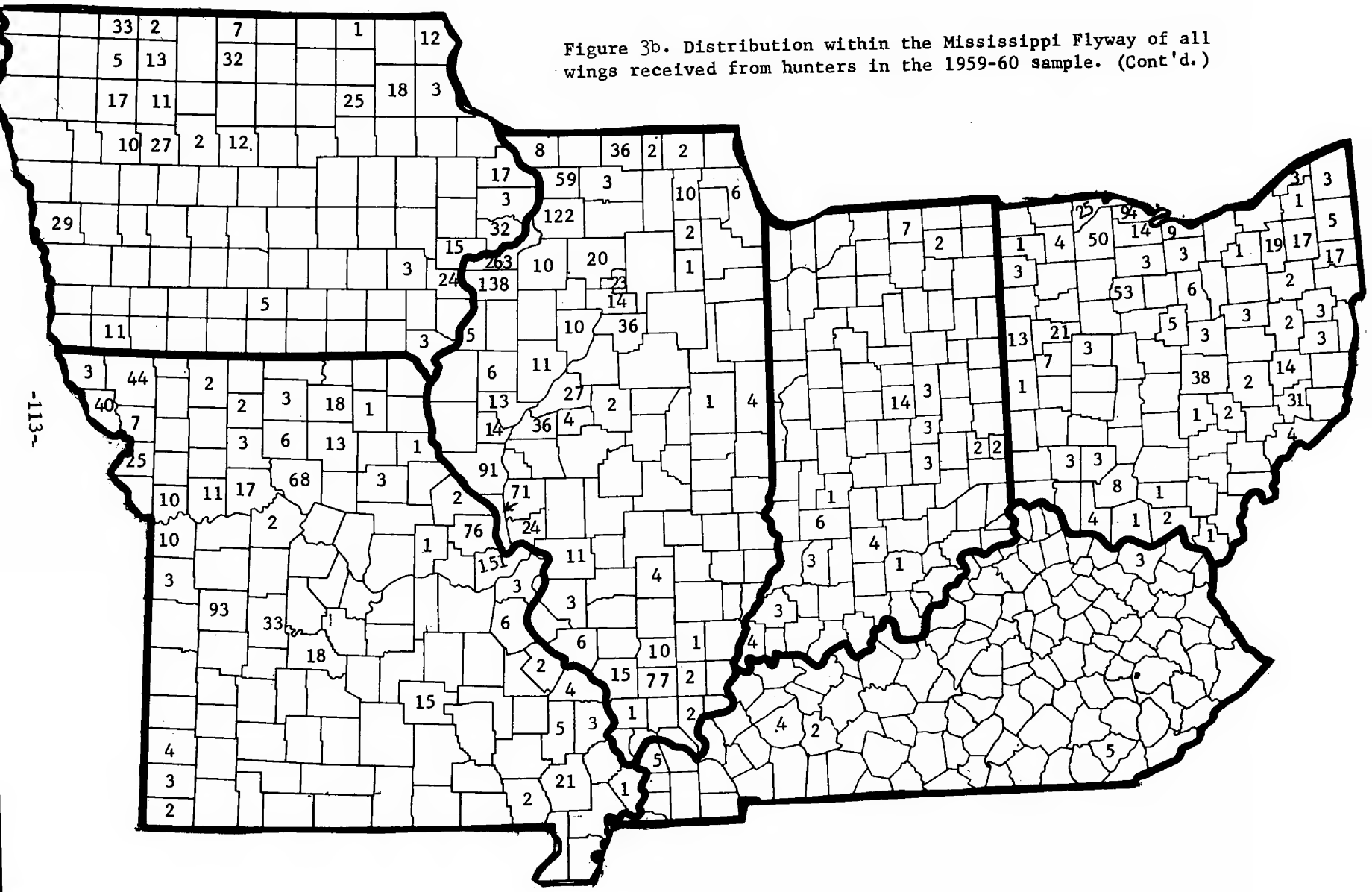


Figure 3b. Distribution within the Mississippi Flyway of all wings received from hunters in the 1959-60 sample. (Cont'd.)

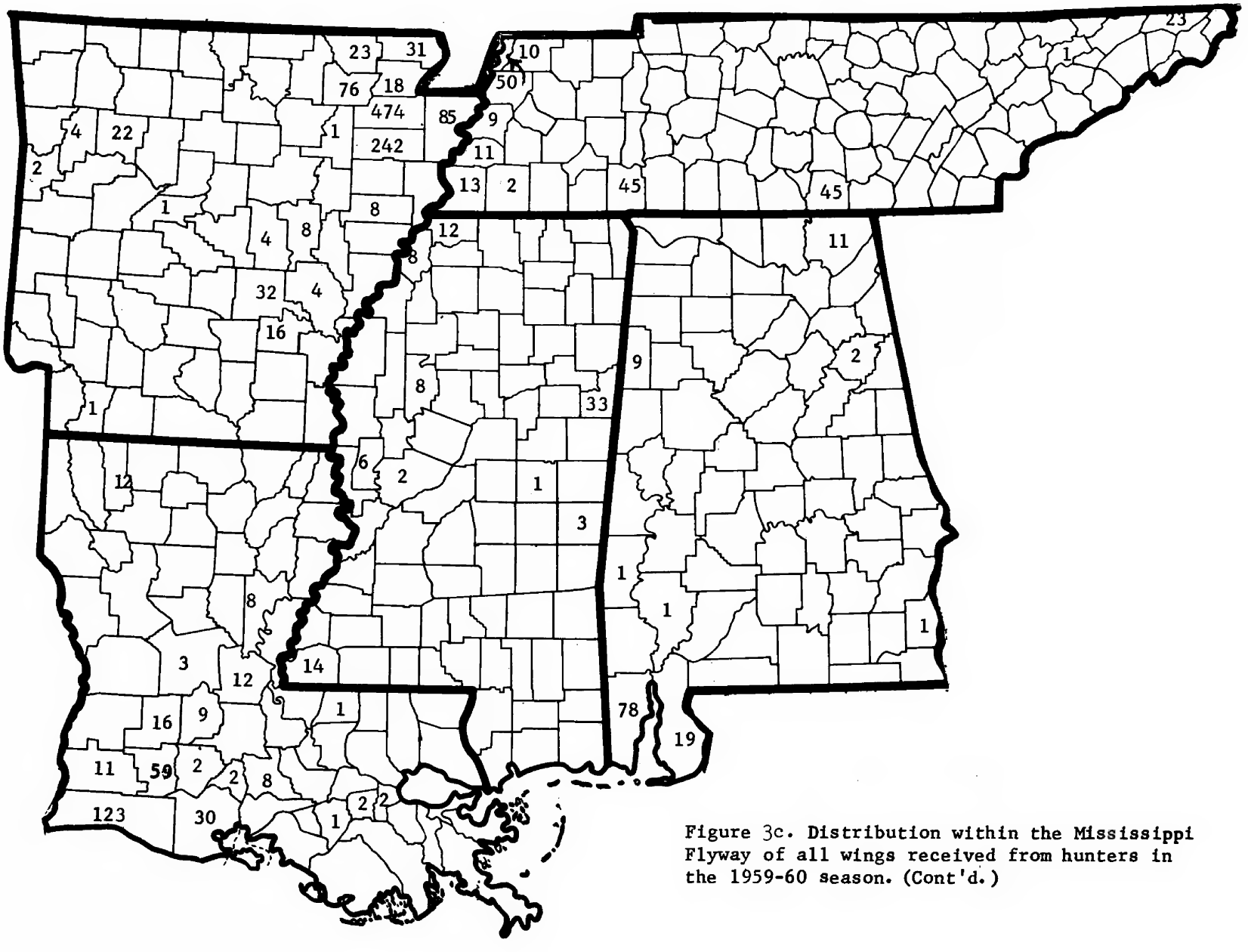


Figure 3c. Distribution within the Mississippi Flyway of all wings received from hunters in the 1959-60 season. (Cont'd.)

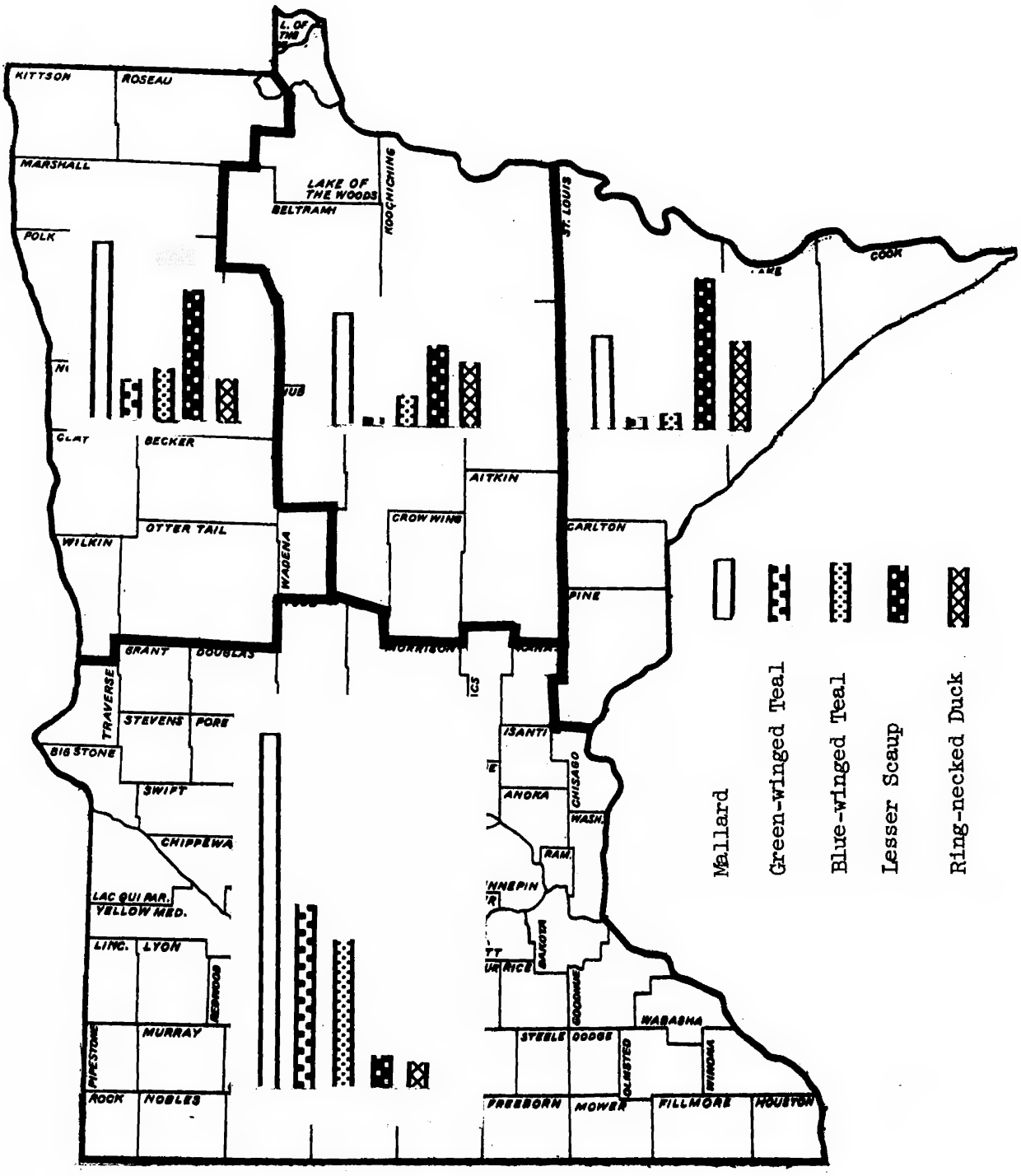
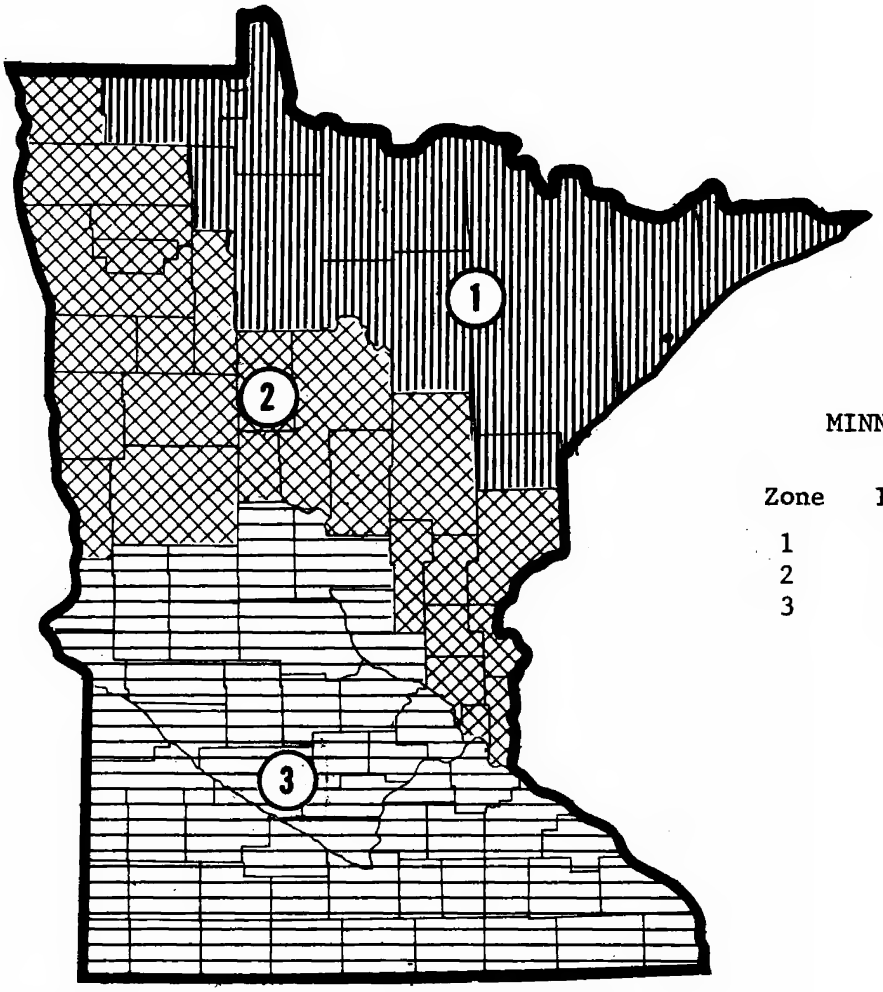
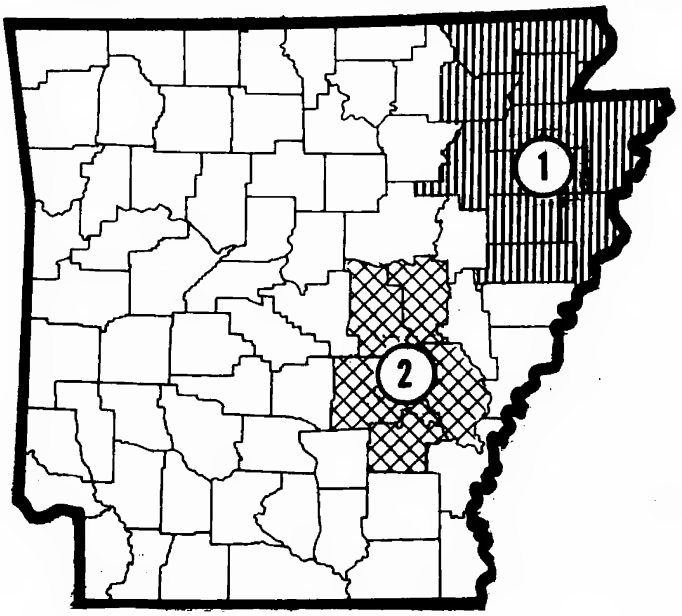


Figure 4. Proportions of five species in the kill in four regions in Minnesota.



MINNESOTA

Zone	Imm/Ad.	Sample Size
1	2.93	216
2	1.44	414
3	0.73	468



ARKANSAS

Zone	Imm/Ad.	Sample Size
1	0.53	830
2	0.27	52

Figure 5. Variation of mallard age ratios within Minnesota and Arkansas.

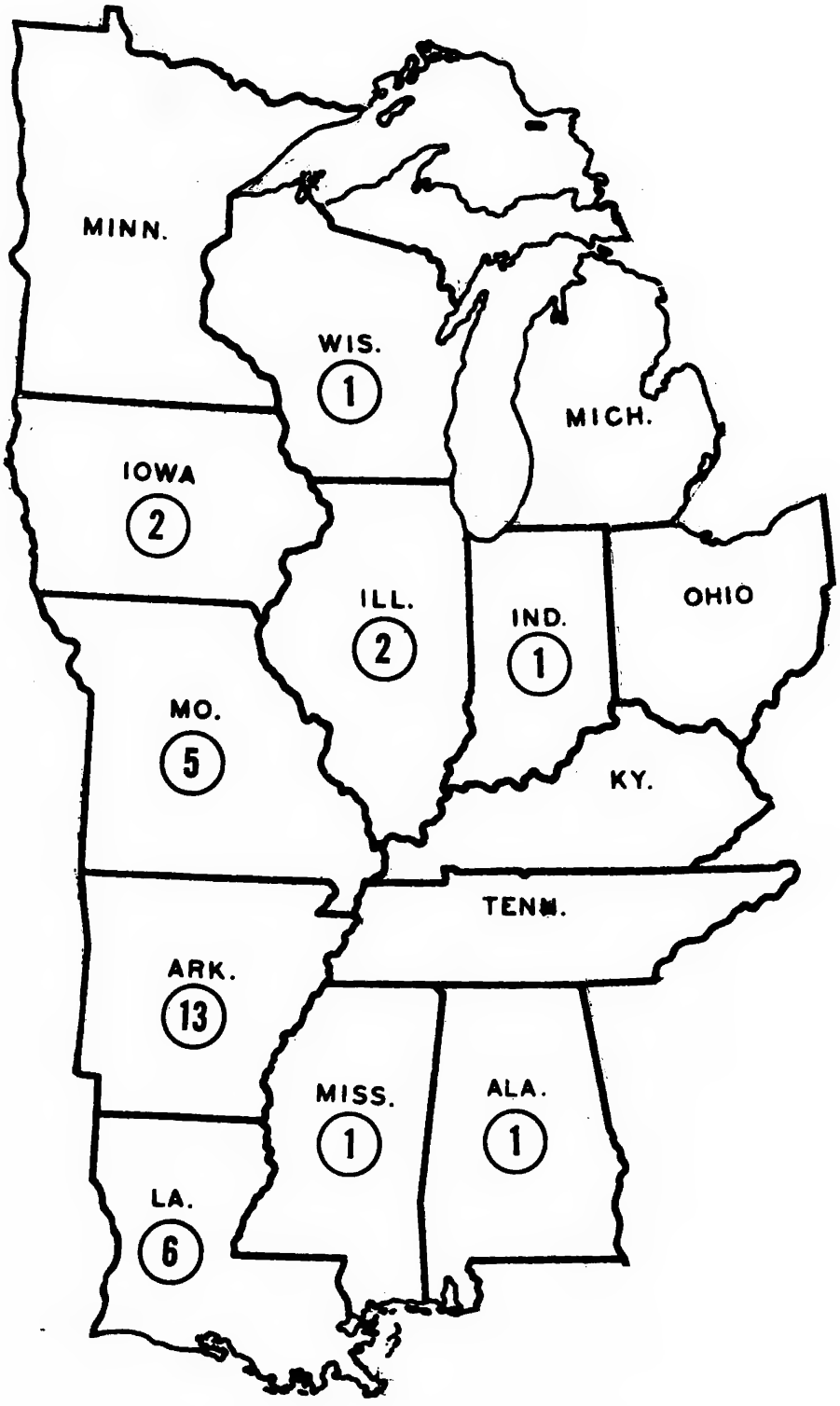


Figure 6. Direct recoveries in the Mississippi Flyway during the 1959-60 season of mallards banded in Saskatchewan, August 1 through September 9, 1959.

APPENDIX

Geographic Distribution of Hunters from Whom Duck Wings Were Solicited

States are arranged in geographical order to simplify regional comparisons. The cities listed represent post offices where hunters purchased their duck stamps and are not necessarily the hunters' places of residence.

MINNESOTA

1817 respondents to 1958 Hunting Season Questionnaire. 249 Fairmont, 226 Duluth, 169 Ely, 153 Appleton, 145 St. Paul, 110 Cambridge, 104 Minneapolis, 98 Frazee, 73 Dent, 66 Winnebago, 50 Granville, 47 Clearbrooks, 41 Cyrus, 38 Chokio, 33 Avon, 32 Bertha, 21 Lowery, 20 Pilager, 16 Lonsdale, 13 North Branch, 12 Dresback, 10 Fairhaven, 91 from 17 other post offices.

WISCONSIN

662 respondents to 1957 Hunting Season Questionnaire. 268 Menosha, 86 Cudahy, 79 Wautoma, 50 Lodi, 48 Park Falls, 21 Brownsville, 20 Clayto, 20 Oxford, 19 Campbellsport, 19 Spring Green, 13 Somerset, 19 from eight other post offices. 414 respondents to 1958 Hunting Season Questionnaire. 101 Hartford, 93 Marion, 47 Milwaukee, 42 Sauk City, 34 Superior, 20 Viola, 18 Pembine, 17 Sister Bay, 14 Haugen, 28 from eight other post offices.

MICHIGAN

534 respondents to 1957 Hunting Season Questionnaire. 232 Monreo, 176 Royal Oak, 45 St. Joseph, 37 Rudyard, 17 Belleville, 13 Sherwood, Four from four other post offices.

IOWA

274 respondents to 1957 Hunting Season Questionnaire. 54 Bettendorf, 38 Milford, 28 Sumner, 26 Marathon, 20 Fayette, 15 Little Sioux, 14 Gillett Grove, 12 Breda, 12 Monson, 12 Wooden, 43 from 16 other post offices.

ILLINOIS

421 respondents to 1957 Hunting Season Questionnaire. 109 Pleasant Hill, 51 Morrison, 38 Delavan, 32 Edwardsville, 24 Dongola, 22 Yorkville, 19 Evansville, 14 Livingston, 12 New Athens, 10 Georgetown, 10 Royaltown, 80 from 36 other post offices. 523 respondents to 1958 Hunting Season Questionnaire. 176 Rock Island, 168 Herrin, 22 Rockford, 19 McNabb, 18 Urbana, 15 Carpenterville, 15 Forest Park, 15 Oregon, 15 Rockton, 11 Chicago, 11 Petersburg, 10 Kane, 28 from nine other post offices.

INDIANA

133 respondents to 1957 Hunting Season Questionnaire. 69 Andersonville, 22 Jeffersonville, 18 Odon, 16 Connersville, eight from two other post offices. 236 respondents to 1958 Hunting Kill Questionnaire. 158 Detroit, 25 Lowell, 23 Curtis, 12 Stanton, 18 from four other post offices.

OHIO

714 respondents to 1958 Hunting Season Questionnaire. 84 Newark, 78 Baltimore, 50 Bowling Green, 45 Ravena, 41 Willowby, 38 St. Marys, 36 Coshocton, 25 Perrysburg, 23 Fostoria, 22 Greenville, 22 Waterville, 19 Miamisburg, 19 Ironton, 19 Hillsboro, 12 North Lima, 11 Englewood, 10 Greenfield, 10 Hudson, 10 Whitehouse, 140 from 45 other post offices.

MISSOURI

770 respondents to 1958 Hunting Season Questionnaire. 95 Clinton, 72 Jackson, 57 Kansas City, 57 St. Louis, 52 O'Fallon, 51 Sedalia, 42 Hale, 37 Forest City, 33 La Plata, 26 Kirksville, 25 St. Joseph, 22 Mendon, 22 Monroe City, 22 Neosho, 21 DeWitt, 21 Skidmore, 20 Salem, 13 Dover, 13 Knob Noster, 11 Middletown, 58 from 16 other post offices.

KENTUCKY

61 respondents to 1957 Hunting Season Questionnaire. 36 Central City, 25 from six other post offices.

ARKANSAS

64 respondents to the 1957 Hunting Season Questionnaire. 56 of these from Clarksville and eight from six other post offices. 494 respondents to the 1958 Hunting Season Questionnaire. 301 from Jonesboro, 72 Manila, 40 Leechville, 20 St. Charles, 16 Tyronza, 12 Delaplaine, and 33 from eight other post offices.

TENNESSEE

231 respondents to 1957 Hunting Season Questionnaire. 77 Millington, 50 Bristol, 45 Savannah, 26 Winchester, 15 Wynnburg, 18 from 13 other post offices.

LOUISIANA

504 respondents to 1957 Hunting Season Questionnaire. 259 Jennings, 80 Kinder, 34 Mamou, 25 Le Compte, 18 Patterson, 13 Napoleanville, 13 Olla, 10 Lutcher, 52 from 28 other post offices.

MISSISSIPPI

157 respondents to 1958 Hunting Season Questionnaire. 63 Columbus, 40 Woodville, 29 Brookhaven, 25 from six other post offices.

ALABAMA

77 respondents to the 1958 Hunting Season Questionnaire. 47 were from Mobile and 21 were from Fort Payne, 9 from three other post offices.

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